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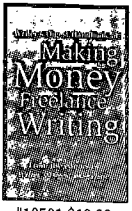

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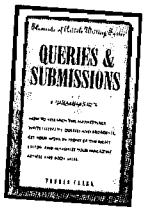

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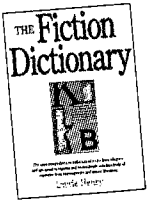

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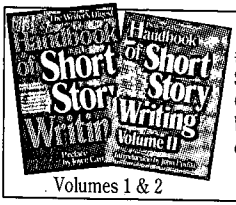

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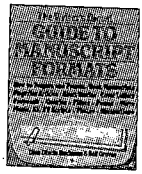

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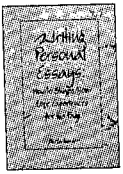

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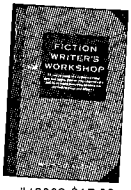

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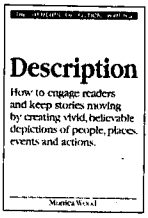
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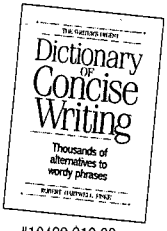

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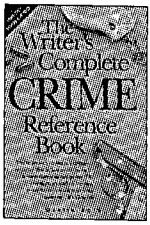

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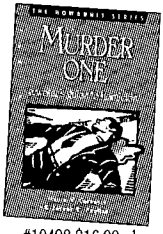

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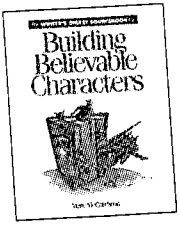

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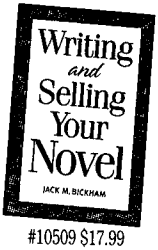

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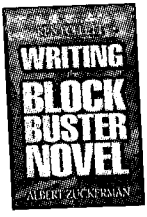

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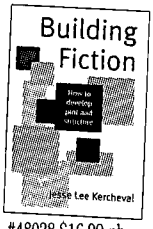

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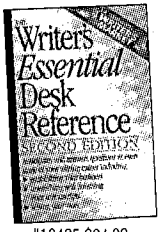

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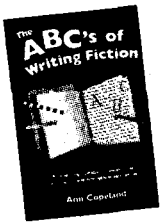

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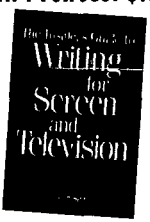

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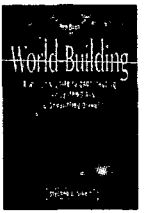

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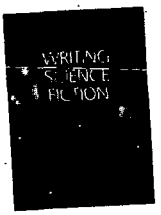

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EDITORIAL Stanley Schmidt

THE FERMI PLAGUE

I think I know the answer. I hope I'm wrong, because what I'm suggesting is *scary*. But it's uncomfortably plausible. . . .

The question is the one commonly known as "the Fermi paradox" and summed up in three words: "Where are they?" Many lines of scientific research suggest that the evolution of life is a natural and common outgrowth of stellar and planetary evolution, and that interstellar communication and travel should be feasible (though not easy). Playing with reasonable guesses for the relevant numbers makes it seem highly likely that we should by now have had some contact with, or at least clear evidence of, at least one other technological civilization from somewhere other than Earth. There is no generally accepted evidence that we have. So where are they?

A great many explanations have been advanced for our lack of evidence of the existence of extraterrestrial civilizations. (A good survey of several of them can be found in two *Analog* articles by David Brin: "Xenology: The New Science of Asking 'Who's Out There?'" [May 1983] and "Just How Dangerous Is the Galaxy?" [July 1985].) Maybe life, for some reason, is harder to originate than we think. Maybe species that *could* be spacefaring decide not to, for one reason or another. Or maybe interstellar empires avoid contact with us because they fear us or don't want to interfere with our development.

And so on.

The trouble with virtually all the proposed solutions, according to many people who've thought about the problem, is that while each of them can explain why we haven't heard from *some* civilizations, it seems unlikely that any of them would apply to *every* place with the potential for producing a spacefaring civilization. Of course, it's not necessary to have a single, simple explanation for a "phenomenon" that may really be a whole group of phenomena that look similar at some level. It may be that we've seen no evidence of Civilization A for *this* reason, none of Civilization B for *that* reason, Civilization C for a third, and so on, with the net result that we haven't seen any. But some people think that if even *one* civilization became capable of spreading to the stars, it would fill the galaxy in an astronomically short time. So shouldn't we have seen or heard from *somebody*?

Is there some one thing that might be so likely to happen eventually to *any* technologically advanced civilization that it would account for "The Great Silence"?

I may have thought of one, after reading a series of articles back in February about an anthrax terrorism scare. Someone was alleged to be in possession of enough anthrax bacillus to wipe out the population of New York City, with the intention of doing just that, by spraying it in the subways. No, I'm not going to suggest that every civilization gets decimated by anthrax; and according to follow-up stories a few days after the initial announcement, the February threat turned out to be a false alarm. (The "weapons," we were told, were actually vaccine.) But it got me thinking. . . .

According to at least some microbiologists, the February bioterrorist threat *could* have been real. Anthrax is one of

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the deadliest and most easily used of all biological weapons. That's why the U.S. armed forces are being vaccinated against it *en masse*. It's fast-acting and almost always fatal. It's cheap and easy to make in large quantities. (Lawrence Korb, a national security expert at the Brookings Institution, called it "a poor man's nuclear weapon.") And it's easy to load into weapons (which may be as simple as insect sprayers or aerosol cans) that spread it in infectious form to everybody in a large region.

And it's only *one* thing with those properties. Other natural pathogens could be used similarly, if not quite as easily or effectively. Both the constant occurrence of natural mutations and the new capability of genetic engineering suggest that still others may be available in the future that have the same properties to an even greater degree.

In other words, for the first time in history, it's now relatively easy for a single individual to unleash a major epidemic. A small conspiracy, involving a mere handful of individuals, could unleash a *really* major epidemic.

In discussions of the Fermi paradox that I've seen, epidemics have not been considered likely causes of extinction of whole species, much less of *all* whole species. Natural plagues develop slowly enough, and usually locally enough, that some individuals will usually survive and develop resistance to them. A population may be decimated, but enough will remain to let it recover.

*Un*natural plagues may be another matter entirely. A combination of technologies, including biological culturing, weapon-building, and rapid global transportation, can make it possible for a very few individuals (or even one) to do things that really *could* wipe out whole populations, possibly even on a planetwide scale.

It would not be a sane thing to do, of course, but that does *not* mean that nobody would ever do it. People commit suicide every day. Some of them are deeply disturbed individuals, more to be pitied than censured, who see suicide as the only way out of their personal problems, and regret the hurt they inflict on those they leave behind. Others go on rampages and gun down crowds of associates or strangers before themselves. If even one of them is a powerful nut who decides to take *everybody* else with him, and knows how, that's all it takes.

And if populations reach into the billions, the chance of one such individual sooner or later arising in any given civilization is disturbingly high. If that happens fast enough, the average life of a technological civilization may be too short for there to be much chance of two of them occurring close enough together in space and time to make contact. Each one may last only as long as it takes to produce one lunatic with too much power at his fingertips.

Any civilization that wants to avoid becoming one of the casualties will have to find an effective answer to the question:

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How do you prevent any individual from acquiring or abusing that much power? No question is more important; and, like most important questions, it's not an easy one. And it needs to be answered rather early in a species' technological career—say, at about the stage where our species is now.

Actually, of course, it's at least two questions. Preventing individuals from abusing great power once they have it is a different problem from making sure they never get it. It may already be too late for us to do the latter; and in any case, it's hard to keep genies in their bottles, and even harder to stuff them back in once they're out.

Controlling what people *do* with liberated genies is another thorny question. Most of us would like to be very careful *how* it's done even if we admit that it needs to be done. Individual freedom and opportunity are widely (and, I think, rightly) regarded as some of the most important genuine accomplishments of civilization. Even if we collectively decide that large amounts of both must be sacrificed to make sure that no kook wipes us all out, who's going to make sure the people or agency with the power to exert that control don't abuse it? It's a very old question; I believe the ancient Romans knew it as *Quis custodiet ipsos custodes?* ("Who will watch the watchmen?")

The only really long-term solution, it might seem, is one that many people would reject as an impossible dream. We need to become a world of people who all have the intelligence, mutual concern, restraint, and decency to live together without killing each other *even if we have the means to do so*. So I pose the challenge to everyone out there, and in particular all you writers who do those thought-experiments about possible futures that give *Analog* its name: How can we make that happen? If it *is* an impossible dream, what's the best we can do instead? How can we preserve for everyone as much freedom as possible to build a good life as he or she conceives it, without putting all of us at the mercy of any deranged or evil entity who gets too much power in his hands? If it's an *almost* possible dream, how can the many who *can* be trusted protect themselves from the very dangerous few who can't? Can we figure out a solution *without* the kick in the pants of a planetwide close call?

Not easy questions, any of them. But they're questions to which we need the best answers we can find.

And we need them *now*.■

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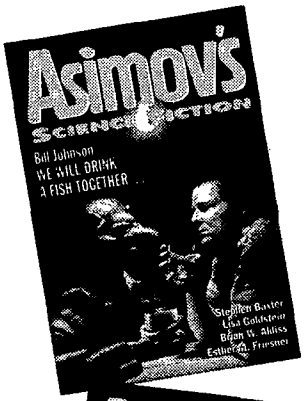

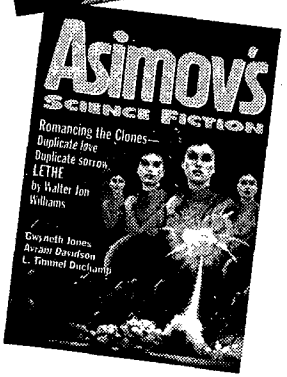

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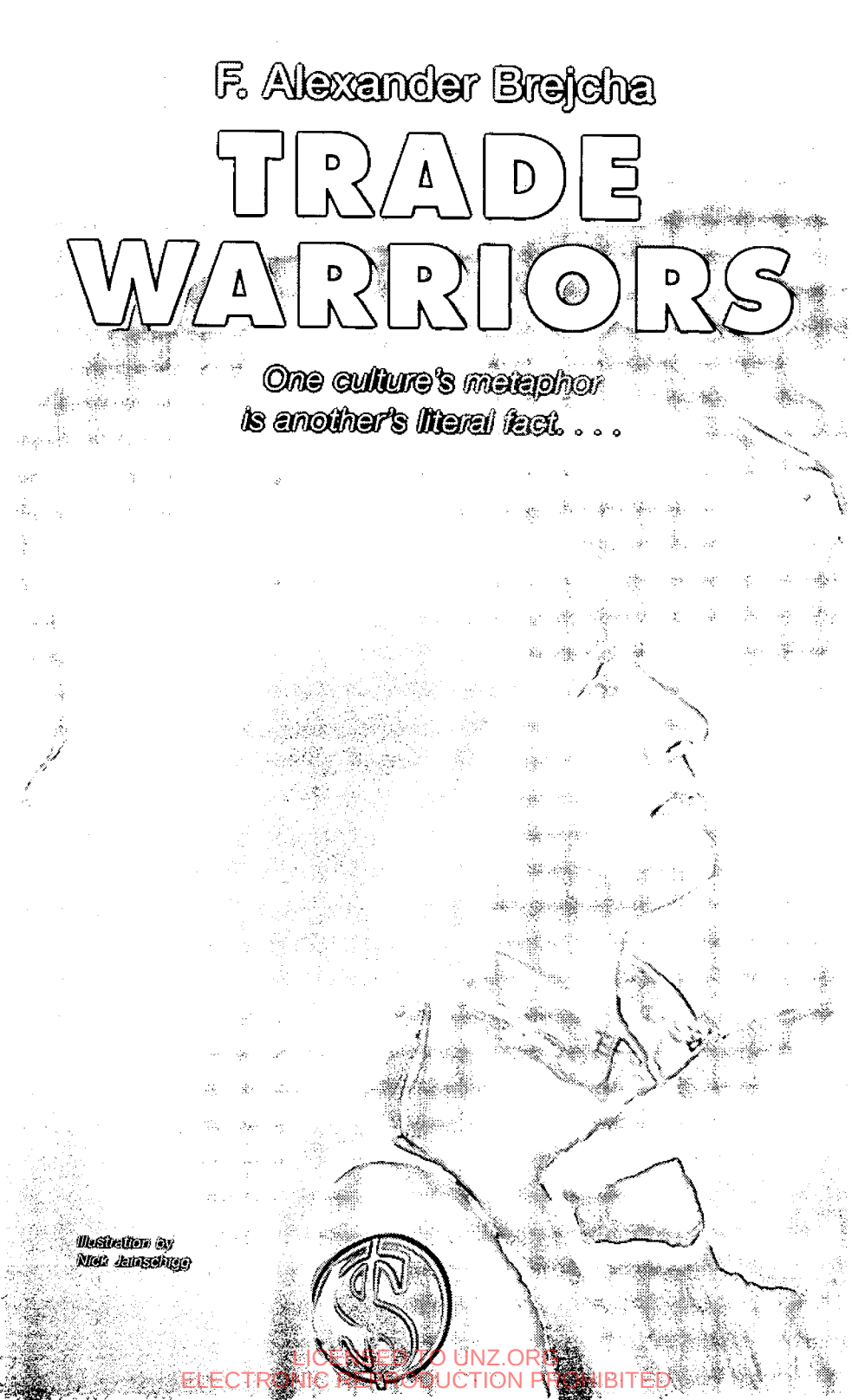
One culture's metaphor is another's literal fact. . . .



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"Eyes to front, Dupree!" the drill commander barked. "You will get no special consideration here, *human*." His fangs flashed as he tapped his open, four-fingered hand rhythmically with the short, spike-covered training baton used to 'encourage' lazy cadets. The unspoken derisive 'female' was equally clear.

My eyes snapped back to the four-legged bulk of the cadet in front of me on the large 'grass' exercise area behind the barracks. Our fifty-cadet Unit was deployed on a field of short blue-green growth that never needed to be cut, but whose sharp-edged leaves could easily slash an unwary person—a human person. The tough-skinned and perpetually naked natives, covered with a short milk and dark chocolate-colored summer fur, were in no danger. And adding to their protection were the leathery pads of their paws. Everything about this planet was like that: tough and unforgiving. Like this school.

Think military academy, I reminded myself for the hundredth time as I looked at the rest of the muscular cadets lined up in meticulous two-toned rows and columns—I couldn't help but be reminded of some highly organized dog show with oversized and steroid-pumped mutant Great Danes, with arms. Their cadet harnesses of black leather were cinched tight and proudly oiled, the single metal slash on each shoulder indicating their lowly cadet rank. Juanth's harness bore the two half-moons of a drill commander. I also wore a harness with a single slash, but over a two-piece, olive-green synth-khaki uniform with a long-sleeved shirt that, along with boots, had been the only concessions the Korthan Academy commander had made after being told how fragile human skin was. But it had been a reluctant allowance and I had to be sure not to take advantage of it. I was a human woman in an alien, all-male military-style training center on a world where females were barely second-class. And this was an academic school! It was easy to forget that the term "Economic Academy" took on a whole different meaning here on Korth by combining the 'best' of a marine boot camp with an Ivy League-type university.

It had been the way the Korthans had eventually learned to control their warlike tendencies after several savage world wars had decimated hundreds of thousands of them. As they were exclusively carnivores and the planet was not as densely populated as Earth, this was a more substantial percentage of the population than similar casualties on Earth. But the Korthans had finally learned their lesson. Eventually they had managed to turn an already competitive attitude towards business into a business style that combined formal personal combat with conventional commercial transactions. And the best way for high-class business schools to prepare their graduates for the literally brutal business environment was to train them in this type of mixed environment.

Of course that meant that school was "boot camp." And as Juanth's reprimand reminded me of that, I resisted the tempting English "Sergeant, yes, sergeant!" I had learned so well in my basic training on Earth, and I kept my mouth shut and my face blank. Korthan cadets spoke only when asked a direct question.

For a moment, Commander Juanth glared up at me, daring me to look at him again instead of ahead of me as I was supposed to. But I didn't need to. His ugly face—resembling that of a pit bull with a bad overbite—was burned into my memory and even if I wouldn't stand a chance in hell yet, I longed for a chance to take him on in a formal Challenge. But that was unheard of for a first-semester cadet. So I kept my eyes front and center and continued with the Korthan equivalent of jumping jacks—which looked a little strange since I only had two legs. But the idea was to spring straight up in the air from a squat while

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doing a quarter turn, while at the same time transferring a heavy training weight from one hand to the other. Korthan arms emerged from their shoulders much like a human's, though they were shorter and their four-fingered hands had minimal wrist flexion.

And as we jumped, I didn't have to see the faces of the other cadets to know that they would have liked nothing better than to get me alone in a dark alley somewhere, because I was outjumping them by a substantial margin. True, I had an advantage because Korth's gravity was slightly lower than Earth's, but I was also a muscular five foot ten to the average Korthan shoulder height of four and a half feet, and my longer legs gave me a definite edge. For the other cadets, jumping up with all four feet off the ground was much more difficult.

Still, they would get their revenge soon enough—when it came time for a forced march with a full pack! Their squat bodies out-massed mine by at least forty percent, and they were ideally suited for long cross-country exercises carrying large packs mounted like oversized saddles. My longer legs wouldn't mean much then.

I tried not to think about it as I went on with my 'jumping jacks' and unfocused my eyes to withdraw into a now-familiar meditation mode, letting my body flex in time to Commander Juanth's barked cadence. Thrust up, twist and transfer the weight, land, squat . . . thrust up, twist and transfer the weight, land, squat . . . . It lacked the grace of a kata, but I pictured myself back in the dojo of my Sensei and Juanth's guttural consonants became the musical timing of Master Takeda. . . .

Fifty years old and already white-haired, the meticulously groomed Takeda-San looked almost like a pajama-clad businessman, until he moved. His movements were those of a cat. Utterly silent and somehow irresistible, he didn't walk from one end of the room as much as he transported himself.

"Excellent, Sugah," he drawled with the disconcerting Southern accent that had never failed to outrage his parents, though it was their own fault for wanting him to assimilate into The Union of Americas as much as possible. Then he nodded in solemn approval as I bowed respectfully and dropped back to my knees. "Pulse?" he asked.

I checked it, but it was near my baseline despite thirty minutes of a strenuous kata.

"Unchanged, Sensei."

He grinned. "Marie, yoh daddy is shoah going to be real happy." His molasses-flavored words were totally at odds with his appearance and with that of the very ethnic tatami-floored wood, paper, and bamboo room. His parents' influence was strong in some respects. Along with having a deep appreciation of Eastern philosophies, Takeda was very traditional in the discipline of his martial arts and his environment—even if he was a born and bred son of the South. Of course, his leisurely Southern drawl had its uses in his 'day' job as a lawyer as it sometimes led people to make the bad mistake of underestimating him. And yet, there had been other times when I had seen him interrogating a hostile witness with a sharp staccato accent more reminiscent of New York than Atlanta. All in all, he was a man of mysterious contrasts whom I felt very fortunate to know as he had been a very interesting teacher, and a long-time good friend.

He reached out to touch my shoulder lightly. "You're almost ready, now."

"Ready for what?" I had my suspicions, but I tried again, getting a bit frustrated. "All I know is that my father asked me to trust him and help him with a critical Solar System Authority project. I'm an Army brat, so I went along with it." I rolled my eyes in resignation. "Then suddenly my martial arts training was put into high gear

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and I was given an indefinite leave of absence from the Officer Candidate School so I could add economics studies and train full-time. But no—"

"But no one ever explained why, other than that it was classified and that you would have a chance to say no if you finished the training successfully," Takeda interrupted with a gentle smile. "Sure must be frustrating, child, but I don't know either. Doctor Dupree called me out of nowhere and asked me to take over your training, full-time. It was a little awkward, but your father was most generous and," he grinned, "my mama didn't raise no fool." I had to chuckle at the slang expression coming from a man with his education. "My partners can cover my case load well enough, and I have to admit it has been fun—if a bit confusing."

And that it had. For unspecified reasons, I had been put into seclusion during my training and my days had been split between an accelerated martial arts training program and strength training, combined with intensive and rigorous instruction in economics and business law. In addition to being a trusted friend of my father, Takeda was a former economics professor turned corporate lawyer who also happened to be an expert in the martial arts: the perfect choice to handle my mysterious instructional program. . . .

"And stop!"

I was snapped back to the present as Commander Juanth ended the exercise abruptly when an internal combustion-powered truck approached, and a full-mooned section commander stepped out to speak briefly with Juanth. With a deep breath, I assumed parade rest, squatting carefully on the dense and treacherously sharp 'grass'. For a moment, Juanth's words had been an incomprehensible garble of sound until my hypno-training kicked back in. Speaking Korthan was painful to human vocal cords, but fortunately cadets were rarely encouraged to speak during drill, so I could rest up my vocal cords for my classwork. This was only week four of a three-year enlistment, but I was already making liberal use of the throat medicine prescribed by the Solar System Authority doctor.

Juanth was still talking to the newcomer in words too hushed to make out over the subdued engine idle, and I smiled as I looked at the bulky muffler and exhaust purifier assembly on the back of the truck. Korth was technologically only late-twentieth century, but air pollution would never be a problem on this world. Like the dogs they vaguely resembled, the natives had an incredibly acute sense of smell, and on this world anti-pollution technology was far ahead of other technological advances because internal combustion motors and coal-fired power plants simply smelled bad. That little irony had not been lost on the environmental lobbies at home which still sought to further clean up after centuries of smog-spewing industry—those efforts now focused on the still technologically lagging Third World.

"Prime Principles recitation," Juanth suddenly roared, startling me as he abruptly spun to face us again. "Proceed!"

The far right candidate in the front row jumped up quickly as the truck pulled away and barked out a hostile, "Acquisition," and then dropped back to parade rest as the candidate to his left popped up with a snapping, "Consolidation," followed one by one, row by row, by a candidate aggressively reciting each Principle in turn: "Expansion, Incorporation, Indenture, Takeover . . ." Then it repeated as the list of principles was finished. When my turn came, I jumped up and gave "Takeover" the suitably belligerent phrasing I knew was expected, and soon after, I smiled as a row back and over to the right a premature "Indenture" was shouted out when 'Incorporation' should have been next.

Everyone froze.

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The short fur on Juanth's back rose ominously around his harness as he stalked towards the errant cadet who was cringing as the others around him tried to pull back as far as possible without actually shifting position.

"Repeat, Hinth." Juanth was barely whispering and not even the wind dared make any noise as the drill commander moved closer and closer.

"Invalid entry, Commander!" Hinth barked weakly. "I meant Incorporation!"

"You *meant* incorporation," Juanth taunted. "You are not sure yet? Will you also be proposing a . . . *merger?*" He gave the term the appropriate sneering accent.

Then he turned and scanned the field. "I know all of you have been wanting to try your hand at a formal Challenge, even if you are too untrained to deserve it. But perhaps this would be an opportunity to see if you have what it takes to be corporate executives. After all, soon enough you will have to challenge an opposing executive in a board meeting." His eyes locked with mine after a moment and his tearing fangs bared briefly in a Korthan grin. "Dupree! Come here—your Challenge!"

The delighted cadets between us—hungry to see me humiliated—magically melted away to either side and I got up hesitantly to move towards him. Hinth growled angrily, humiliated by Juanth's choice of challengers, and I knew I had better watch my step. As the *female* outsider forced on the school by a government anxious for trade with Earth but trapped by its own rules about trading only with Economic Academy graduates, Juanth had picked me deliberately to teach both of us a lesson. He wasted no opportunity to let me know how much he resented having to have me in his Unit.

I swallowed. Even if I had been too curious to turn down the chance to volunteer for this mission, I had also been trapped by a government anxious for trade. The Korthans had only allowed Earth to send a single representative for the initial trial trade talks, and I had been selected to be the Solar System Authority's representative as a peace-offering to a powerful feminist-activist lobby offended by the concept of Earth trading with a male-dominated and supremely chauvinistic race. And while I had trained for just this kind of Challenge, I would be fighting an opponent motivated by more than just a desire to win a Challenge. If I beat him, Hinth would be the laughingstock of the academy and I would be reviled as the "human female" who had humiliated a good Korthan male cadet.

But maybe Juanth would have to treat me with a bit more respect?

Okay, Takeda! Stay with me! I closed my eyes briefly and reviewed all the lessons he and the exo-physiologists had drummed into me. In addition to a slight strength advantage, I also had better speed, mobility, and reach, but the Korthans had the advantage of mass, stability, and an ability to absorb—and with their horselike hind legs, deliver—blows that could break my bones. Normally, I would be safe because a true Challenge was an exercise in restraint and style where the ideal defeat of your opponent was accomplished with a minimum of damage to him. But I had a feeling Hinth would not be quite as constrained by etiquette as a normal Challenge dictated.

Looking around I saw that this was a much-anticipated confrontation.

Juanth's call to a Challenge had freed the other cadets to rearrange themselves into the traditional Circle of Challenge around Hinth and myself, with Juanth between us as the referee. From their hyena-like hunched shoulders and thrusting heads, I knew everyone was looking for Hinth to show me how outclassed I was.

Juanth moved out of the way and nodded. As the Challenger, the first move was mine and I had to smile as I gave a Korthan bow to yield first move, which when I did it looked more like a curtsy

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than anything. Hinth snarled in response, reminding me what my grin looked like to the others, but the gathered cadets approved of my apparently fearless threat gesture and I heard an expectant, almost subaudible growl spread through the waiting ranks.

I had no sooner straightened than Hinth charged ahead in an explosive attack. I threw myself forward to meet him, but—remembering Takeda—I dropped to the ground at the last minute and rolled, striking up with a straight blow to the belly as I tripped Hinth by rolling into his legs and bowling him over.

The circling cadets roared in approval, not averse to a better fight than expected.

Hinth rolled with a strangled snarl and landed heavily on his side gasping for breath as I got to my feet and brushed myself off. My uniform was torn where his rear claws had ripped it as I rolled under him, but other than a few cuts from the sharp grass blades and some skin tears from his claws that were barely bleeding, I was unhurt.

And since I was standing and he was not, I bowed again to give him a chance to surrender, but with a savage bellow he sprang to his feet and lunged at me again with his arms outstretched. I knew I'd never get away with the same maneuver twice, but I rushed him as if I was going to, and at the last minute as he ducked to try to catch me, I jumped to vault over him—only to slam right into his chest as he rose up on his rear legs to grab me and knock me down with his arms and forelegs. He had anticipated my move!

Dazed by the impact, I couldn't move as his arms wrapped around me and he threw me to the ground, and then the bulk of his body crashed down on me. I heard a snap from my right arm as an incredible surge of pain almost blacked me out.

"STOP!" I heard Juanth roar and I realized he had been calling out before.

Hinth rose and backed away from me, his hackles still raised, and from the way he was snarling, I realized that only the iron rules against using one's fangs had spared me a major mauling.

"What kind of Challenge do you call that, Cadet?" Juanth barked angrily to Hinth. "That was the most ungraceful, undisciplined, and—"

"It was my fault, Commander," I interrupted as I struggled to my feet, trying to keep from blacking out from the pain. My right arm was definitely broken. Only Takeda's training in body control let me remove my focus from the pain to try to speak without crying out.

The restless cadets around us were silent, and both Hinth and Juanth were staring at me.

"I attempted a different attack maneuver," I invented as I had an idea, "and I miscalculated and got in Hinth's way before he could stop himself." I bowed low so my forehead touched the ground as a gesture of surrender, literally blacking out for a brief moment from the sudden surge of pain. Juanth caught me before I fell over and helped me brusquely to my feet.

All around me, the other cadets sat expectantly waiting to see what Hinth's reaction to my obvious lie would be.

Hinth's fur relaxed, and after a moment he bowed slowly in respect, and as if that had been a cue, cadet after cadet around us followed suit.

Juanth didn't budge, and from the furrowing of his muzzle and tilt of his ears I had a feeling that I had only made him more of an enemy than before.

But as far as the other cadets were concerned, my improvisation had worked.

The government coaches who had filled me in on Korthan society had stressed that I would have to be the best in order to win respect, and that I had to be sure to win in as many Challenges as possible in order to try to gain any measure of respect. But Takeda's teaching had always had a richer philosophy be-

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hind it, and I had decided that in this case it had been more important to lose with dignity. That way I would save 'face' for Hinth, and potentially earn respect from the rest of the cadets and from Juanth. But the drill commander's reaction puzzled me.

"Go to the infirmary, Dupree," he ordered briskly and turned his back on me. "Dismissed." Then he surveyed the rest of the cadets disparagingly and growled: "What is this lack of discipline? Return to drill formation!"

I sighed and made my way back to the barracks, knowing I couldn't expect an ambulance or a ride. After all, it was only a broken arm. . . .

"Miss Dupree, sir." Director-General Zachariah Connor's secretary introduced me and withdrew in the practiced and graceful low gravity ballet known as the Lunar Slide.

But since this was my first visit to the Moon and I had only been up here a few hours, my efforts could still be best described as the Kangaroo Hop. So I aimed myself at the closest chair as Zach got up from behind his desk with a sympathetic grin to envelop me in a trademark bear hug.

"Come in, Marie, come in!" At six foot six and massing over one hundred-ten kilos, the bearded Solar System Authority leader was a forbidding figure, if you didn't know that he had a soft heart that he kept well-hidden from all but his closest friends—like my father. They had gone through West Point together, after which my father had continued his medical training to become an army surgeon. Zach, in the meantime, had thrown himself into his career to rise rapidly in the ranks of the SSA Peace Forces. Then after being promoted on up to the rank of general, he had decided to retire and channel his energies into the political arena. He had been equally successful there, and after a number of increasingly important elected posts in the United Earth Authority, he had been appointed to a ten-year term as head of the Solar System Authority—a new version of the old United Nations that incorporated Earth and the Lunar Settlements, the Mars Project Colony that was slowly terraforming Mars, and the disparate mining settlements of the Belt Conglomerate.

But Zach and my father had kept both a professional and a personal relationship going over the years, the latter expanding as each had married, and I had grown up to think of Zach and his wife as 'Uncle Zach and Aunt Maura'.

And now that Takeda had 'graduated' me, and I had been picked from a dozen different candidates, Zach was finally going to reveal what the mystery behind my training was.

He led me over to the delicate-looking lounge chairs by the wide viewscreen that seemed to look out over Mare Crisium. "Here, sit!"

I sank into one of the chairs gratefully and looked over at him as he dropped into the next one gingerly. But it held.

"Good thing we're not on Earth," he quipped, and then leaned back to ask:

"So, what do you know about the Korthans?"

I grinned as I realized that I had been right. For several months before my father had approached me, there had been news about the alien planet that had been contacted after the return of one of the dozens of cryogenically frozen solo explorers sent out almost eighty years earlier with sub-light Jump Gate missions. Gaters had been popping back through the waiting Solar Gateway for years, but always with surveys of systems of interest only to scientists—until Guarrinder Subraminin had returned with a preliminary survey of Korth.

"You don't seem surprised," Zach pressed.

I shrugged. "No. I've suspected it ever

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since you and dad started me training with Takeda. Ever since exploration started, the media have been full of reports on the aliens, and their business habits. And Marilyn Hansen and her Femme coalition haven't exactly been quiet in their protests about us setting up diplomatic relations with the 'sexist' Korth."

"No, they haven't. And they've blackmailed us into using a female candidate." He frowned. "But ever since they joined forces with the Isolationists, they almost scuttled our plans for contact altogether. The Isos joined them because they insist it would be too much of a shock for the Korthans for us to be contacting them prematurely."

I shook my head. "Shock? They were delighted! The way they're hungering for new trade markets, they can't wait!"

"Precisely. But their economic rules are inflexible, and all bets are off if we don't graduate a candidate from their main Economic Academy—"

"Which is why I had all the bookwork along with the training."

"Uh-huh. And there's more."

I didn't like the look on his face. "What else?"

"Only one candidate at a time, so you're on your own, and to make it more difficult, each Academy cadet is only allowed to enter the Academy with a set amount of funds in a special personal account kept in the school bank for the three-year duration of the program, and everyone has to pay for their own room, food, clothing, and all other personal expenses out of that account. But the average total of those expenses is at least twice as much as the allowed opening balance on a cadet's account. And no outside funds may be added to the account."

I started to understand. "And let me guess: one of the graduation requirements is to have just as much money left in that account as the opening balance."

Zach grinned. "Wrong. You have to show a healthy profit. This is a business school, after all. You're allowed a business loan from the school and a negative balance the first two years to allow for start-up expenses—though you lose points for a negative balance the second year—but for the last year you have to show an average annual profit of at least forty percent. This is an honors academy after all, not some micro-credit night school."

"A profit. So I have to develop and run a business on my own?"

"You got it."

"With what limitations?"

"None. But anything original you can come up with, can be copied by other students—and vice versa, of course. You can even check the library for previous student businesses and copy them."

I recognized the expectant silence that followed and took a guess: "But I get extra points for originality?"

Zach nodded happily. "Yes, and points get deducted for copying someone else's business unless you make substantial improvements, or run it at a greater profit margin."

I frowned. "I'm going to be at a hell of a disadvantage. I don't know their markets, their businesses . . . or anything about their economy. All I've learned recently has been theoretical economics, from a human perspective."

"Well, you'll have time to learn. Now that you've been selected, you'll have access to all our research data on the Korth—including the school library."

He chuckled, and I leaned forward as I realized he wasn't thinking about the library.

"What?"

"It's just that UFO watchers have been harping about alien abductions, spies, and surveillance for centuries—and here we have been stealthily spying on another race for several years to learn their language and customs, and we're the 'aliens'!"

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"Have we abducted any of them?" I was joking, but when I saw the way his eyes skipped away, I felt uneasy. And he knew it as I leaned forward.

"Marie," he stopped me, "that's on a need to know —"

"Bullshit! I want to know! Just you and me."

He nodded reluctantly. "We had to be certain there was no risk of infection. We were very careful. Once we had taken animal samples and plant samples, we retrieved some dead bodies from a plane wreck to learn about their physiology—and that told us how to anesthetize them safely —"

"So you just swooped down and took samples to examine?" I remembered seeing some pretty graphic classic science fiction movies like that and I shivered.

"We needed more data, and they never felt a thing," Zach protested. "And all sampling was done with full sterile precautions so that there was no infection risk, in either direction."

My mind was filled with images of tiny aliens with big oval black eyes clustered around a helpless, screaming woman strapped to a metal exam table while a metal probe descended relentlessly towards her face.

"It was for their safety!" Zach protested.

"It's wrong!" I couldn't look at him, and I just stared out at the relayed image of the stark lunar surface. It was sunrise, and the sterile landscape was full of sharply defined black and white, no grey areas there.

Zach seemed to be reading my mind as he reached over to take my hand.

"In a world run by votes and committees, there are compromises. But we need the Korthans, too. Really. And this way it at least gives them a chance to benefit."

"What can a planet with twentieth-century technology offer us that's so important?" I wondered. . . .

"Settle on the bench. . . ." The infirmary doctor looked around helplessly for a minute as it dawned on him that the Korthan equivalent of an exam table wasn't exactly suited for my anatomy.

I just shrugged and sat down on the edge of it anyway. It looked a little like a low bench, but was curved in to cradle the abdomen of a Korthan, and with indentations for the four legs. It was designed to lift up—a little like an old hydraulic car lift in a service station—to hold the patient suspended in mid-air. Sections of the underside of the table could even be opened to allow access to the belly.

"Let me see your arm," Healer Gyrnth asked as he pressed a control with a foot to raise the table slightly so my knees weren't up around my chin. I had just deciphered the Hebrew-like script on the name tag molded into his blue, instrument-studded medical harness.

The infirmary medic had already removed my harness, cut off my shirt sleeve, and given me a shot of pain medicine from a supply locker labelled "Cadet Alien", but the medicine had not kicked in yet. The pain was unbelievable as I held up my arm gingerly—only Takeda's training kept me from screaming—so that Gyrnth could get a good look at it. The forearm was already swollen and magnificently bruised.

"It's broken, I just know it," I managed through clenched teeth.

"We will know for sure in a moment," he grunted unsympathetically and triggered an X-ray unit that descended from the ceiling, complete with a radiation shield for the operator. Then he disappeared for the moment before returning with a heavy blanket he draped in my lap and pulled up to cover my abdomen.

"I have been briefed on your anatomy," he explained, "and this will protect your reproductive organs."

He moved my arm to hang down as if it was a Korthan's leg and positioned the plate holder behind it, and then moved the emitter tube into place and retreated behind the shield to trigger it. He took

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several plates from different angles, surprisingly careful as he repositioned my arm, though by then the medicine had taken effect and I could only feel a dull throbbing.

"Remain here while I process the plates," he cautioned as he collected the plates and headed for the door. . . .

"Don't be too quick to consider them primitive," Zach cautioned as I questioned the benefits to us from contacting a less advanced world. "It's true that technologically they're way behind us, but when it comes to medicine, they are surprisingly sophisticated." He leaned forward. "It has to do with their mortality. They are cursed in several ways. First of all, due to some changes in their sun over the past millennia, increased radiation has resulted in some genetic damage leading to a very high infant mortality. That means that females have had to carry more . . . litters—which in part explains the gender inequality. Since females are frequently pregnant and not equal in hunting at those times, they have never been able to overcome millennia of being 'barefoot and pregnant'." He shook his head wryly. "Literally, in this case."

"And there's more," he went on. "Population pressures and the territorial demands of a species of free-ranging carnivores meant that historically, the Korthans have a very bloody past. They did develop animal husbandry—one reason their society has evolved—and their pack mentality has meant a strong focus on pack survival, which meant treating their own as effectively as possible to keep up a good fighting force—"

"And that's translated to well-developed medical skills in a more modern society," I cut in as I saw where he was going. "And if solar radiation is still a problem, I can only assume that they are very advanced in preventing and treating radiation damage . . ." I stopped as I had a wild idea. "The Jump Gates! Don't tell me that one of their treatments can prevent Jump Gate Syndrome?"

I stared at him as that possibility hit me. JGS had been the one negative effect of the Gates that no one had been able to overcome. Unable to operate closer to the Sun than the orbit of Mars, the Gates had taken decades to develop after theory had progressed to initial trial experiments. Thousands of test animals had been sacrificed to perfect them, but finally they had seemed safe and human testing had begun—and volunteers had started dying. Not immediately, but apparently some form of radiation generated by the transport had cumulative effects, and after more than four jumps, terminal brain damage developed.

And as I drew the obvious conclusion about the Korthan research, Zach nodded, a little annoyed that I had stolen his thunder.

"Yup. We've been analyzing some of their treatments, and several of them look promising under computer modeling. More research will be needed, but it seems that the local flora and fauna has adapted to the increased radiation in some interesting ways, and if our medical specialists and theirs put their heads together, I'm sure we can come up with an effective way to prevent JGS. Do you realize what that means?" His eyes were sparkling.

I did, and I could see why he was so excited. The prospect of unrestricted Jump Gate travel for people had been the Holy Grail of researchers—especially now that contact had been established with another race—but it had seemed an impossibility. Near real-time data communication and physical goods exchanges were great, but for many, not enough. But now unlimited travel might also be possible . . . thanks to a world with only twentieth century technology . . .

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"Cadet?" Gyrnth came back into the exam room with a large folder and I stood up expectantly.

"So what's the verdict?" He looked confused and I rephrased my question and he nodded and pulled out one of the films to hang it up on a display light.

"It's a simple fracture that I can take care of right here." He sounded disappointed, as if he had been hoping for at least a nice compound fracture. "My medic will start you on a four-day course of twice-daily sonic treatments and fit you with a temporary immobilizer. If you take the medication I'm prescribing, the bone will be partially knit in two days—"

"Two days?" I stared.

His head bobbed. "Yes. The drugs I want you to take will accelerate your metabolism and speed up the healing of the bone. You will also have to eat large doses of a diet very high in protein, minerals, and carbohydrates that I will prescribe, but the bone should be knit within a couple of days, and as strong as new in a few more." He wrote down some directions on a pad and then looked up.

"And you are not to participate in Drill for five days," he warned, "or I will have you docked one credit unit for every violation." It didn't even occur to him I might appreciate a break. "I will not have my hard work undone," he added with a frown. Then he tore off his scribbled directions and handed them to me. "Your account has already been charged for my services, the drugs, and the sonic treatments, so I should have no reason to see you again." And with that acerbic comment, he spun and left me alone in the sterile exam room to wait for the medic.

Two months—and many throat lozenges—later, I had my final business plan together. I had decided early on that for it to be effective, I would have to do something very unorthodox—for Korth. So I had decided to call on my best possible ally.

I hoped I had not made a mistake as I got the expected reaction.

"You are going to do what?" Hinth's head thrust forward and his tongue hung out in disbelief.

"Sell clothing and jewelry door to door," I repeated with a grin. Hinth didn't even flinch. By now my 'peculiar facial spasms', as one of my instructors had called it, no longer caused any reactions.

"And you intend using females for this?" His head was twisted almost ninety degrees and I held back a shudder. It looked painful, even if it was just a Korthan's way of registering befuddlement.

"Yes, but I need help." Hinth's head rotated in the opposite direction. A chiropractor would go out of business on this planet! "I know that sounds a little strange, but there is no rule against two cadets working together on a business—"

"Mergers are for weaklings!" he cut me off as he pulled back in disapproval. "And I will not subordinate myself to a female."

"This technically isn't a 'merger'," I corrected, ignoring his crack about my gender and our roles. I had learned not to take that personally. "What if it increases profits?"

Hinth settled on his haunches uncertainly. "Increases profits?"

"Yes. I have a business plan involving multi-level marketing."

I thought I heard a slight crackle of cartilage that time and I smiled. *Yup*, this world was ripe for it. I thought again about what I had seen on the few occasions I had been able to make an excursion into the nearest town—accompanied by an "escort" of local police and followed by a parade of gawking Korthans.

The females were virtually identical to the males except for a line of four barely visible nipples and a solidly milk chocolate-colored coat that was in contrast to the darker brown legs and heads of the

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males. And there had been another difference. Some of the females also wore harnesses, but ones made out of brightly colored fabrics decorated by complex jewelry. Hinth had told me that successful males decorated their mates in this manner to show off to others that they could afford to free their mates from household drudgery—they hired unmarried females for that.

"Tell me again how a household budget is managed," I asked him.

"Bonded females are given an allotment of capital to run their households based on the income of their mates," Hinth explained. "That must cover all expenses such as food, cleaning supplies, utilities, and whatever else is needed. If there are children, additional funds are provided. Unbonded females of any age live at home, and unbonded males are expected to care for themselves once they come of age. If they cannot get a sponsorship for business school and an apprenticeship, they must work public service jobs until they able to make it on their own."

"How about entertainment? Do the females have any discretionary spending?" I pressed.

"That depends on their Bonded. If he does well in business, he is usually generous because that shows his success."

"Just what I thought!" I grinned.

Everything pointed to a class of females already capable of managing money and budgets, and probably dying to show off a little—and even better, their Bonded wouldn't fight too much at first because it would make them look more successful. My only problem would be overcoming prejudices against females treading on male ground by doing any sort of business. But male disinterest in female activities would work in my favor for a while, and my business was clear in my mind as I leaned forward.

"You're going to be my supplier," I explained. "I need a cheap, reliable wholesale source of jewelry and fabrics—someone who can manufacture to my designs—"

"Which I will mark up and sell to you—"

"And which I in turn will mark up a little more—"

"And sell retail?" Hinth sneered knowing I couldn't possibly get much of a reputation as a single retailer.

"Oh no." I grinned. "This is where multi-level marketing comes in." I explained how I would recruit a selection of representatives who would buy from me, and who would then recruit representatives below them—and all of whom would kick a percentage of their sales back up—ultimately to me.

As I laid out the principles of multi-level marketing to him, his head turned further and further and his eyes grew wider as he absorbed the profits that could be had from a cooperative marketing technique alien to normal Korthan business practices.

Finally he sighed and settled back on his haunches. "I now understand why you made me sign a nondisclosure agreement binding me into a partnership for the duration of our Academy program." His tongue flickered in and out in rueful thought. "I could make a fortune—and from females!" He was still having a hard time embracing that concept.

"You still can," I pointed out. "As my exclusive supplier. And the better I do, the better you do."

His tongue vanished and fangs gleamed briefly. "Yes, that's true." He immediately looked less disconcerted. "So what do you need?"

I pulled out my computer and displayed the selection of jewelry I had carefully designed by drawing on empowering figures in Korthan mythology, and then I displayed the 'clothing' I had improvised by taking existing designs and making them a bit bolder and more concealing. In this case 'more' could very well have the same effect as 'less' on Earth, by adding to the mys-

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tery. And from the rapt attention Hinth was paying to the clothing models I had computer modeled wearing the new designs, I had the feeling my instincts had been right. I had a hard time getting his attention as I tried to tell him how I wanted to proceed. Finally I just turned the display off and smiled as he slumped in disappointment and turned to me reluctantly.

"Those designs are very daring."

"That's the idea. We have to distract their mates from the fact that they are making money on their own." *And that they are making money in a more efficient way*, I added mentally. *Better not mention that.*

"And making money for us," he added with relish.

"Exactly." I handed him a memory crystal with my designs. I didn't bother cautioning him on confidentiality because I knew he had no intention of losing any profits. "Now you get going on the manufacturing end, because I am heading into town to set up my distribution network." I had already picked my targets by scanning the Korthan equivalent of the social register in order to pick the top of my downline. I had an appointment with the mate of the town's C.E.O.—even local governments were set up on a business model, which was something a lot of cities on Earth probably could have benefited from.

And as Hinth left, I packed up the printouts I had made of my designs—my customers needed something to hold—and changed into civilian clothes, which was permitted when leaving the Academy on scheduled business. As an alien, I'd be stuck with an escort, but I had learned to ignore them. Besides, they would not be admitted to my meeting. I kept my face neutral as I left, to avoid confusing my escort and the other cadets, but inside I was grinning up a storm. All the other cadets were dying to know what my business venture was, and they had no doubt bribed my escort and set up spies in town to try to keep an eye on me. But they'd never get any information from where I was going!

A year-and-a-half later there wasn't a Korthan alive who didn't know what Hinth and I had been up to. A student petition to expel us from the Academy had been filed—and summarily dismissed—as soon as the word got out, and now we were both the bane and envy of every other cadet who didn't dare copy us because they'd never be able to surpass our success. But many of them wished like hell they would have thought of my business first. Hinth, who had initially resented a subordinate role to a female, had countered by coming up with some superb variations and expansions of my own business plan—once he had overcome his prejudices against a cooperative business, he had been quick to seize on its potential. I had let him implement them on his own, and now there was no longer any doubt in his mind, or mine, that he was a full partner. And more importantly, our class advisors were equally convinced.

But I was a little concerned about the peremptory summons from Administration that demanded that both Hinth and I report to the Academy C.E.O.

"What do you think he wants?" Hinth wondered a bit nervously as we waited in the outer office. "Another expulsion petition for un-Korthan business practices?"

I shook my head. "C.E.O. Drinth was quick to dismiss the first one." I quoted him from memory: "'As long as a cadet is making a profit, unconventional business methods are not sufficient cause for action provided no regulations or laws are broken.' Besides, he doesn't have any patience for sour grapes . . . er, envy," I amended as Hinth threatened to throw his neck out of joint again. "He values original ideas above all else."

"We are certainly being original," Hinth's head bobbed with a flash of fangs.

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From his expression I could tell he was mentally tallying his Academy bank account, which already held more than fifty times the amount that he had been admitted with—as did mine. And our accounts would have been even fatter except for capital expenses we had incurred in expanding the business to several neighboring cities where our downline had relatives and friends who had been brought into the business. By the end of our second year at the Academy we would have our return on that, and Hinth and I had already planned for him to buy me out. And at that point, he planned to drop out of the Academy to take the company continental at first, and then global. That would give me such a profit of my own that I would be able to coast for the last year without even touching my principal. The interest alone would be more than enough to cover my expenses.

Our self-congratulatory musings were interrupted by the assistant who ushered us into Drinth's office—where I was shocked to find the hulking figure of Zachariah Connor sitting there awkwardly on the edge of a Korthan lounger.

"Hey there, girl!" He levered himself up and shot me a big grin. "I hear you're doing some fiscal butt-kicking here!"

"Zach!" I couldn't help myself and ran to get gathered up in a giant smoke-scented bear-hug. "Still puffing those pipes, huh?"

"*Shhhh!* Maura thinks I've stopped," he whispered conspiratorially.

"I won't tell."

Drinth waited patiently as I finally extricated myself and Zach sat back down with a groan.

"I've got to spend more time under full gravity! I'm getting weak!"

"Serves you right." I grinned. "So what brings you here?"

"For one, I've never been away from Earth System and it's high time I got into the field. And on top of that, you're making such waves here that the Korthan Global C.E.O. himself asked for my personal attention."

"Oh?" I perched on the edge of another 'chair'.

"Yup. Frankly, he wants you gone. I've spent most of the day with him playing musical requests. On the one hand, he wants your little business shut down, but on the other, he didn't want to antagonize me and lose trade with Earth."

"You have no idea what you're doing to this world!" he exclaimed. "Your little Academy business exercise is catching fire all over the world and Korthan females all over are jumping on the bandwagon and organizing businesses of their own."

"Must be terribly distressing," I responded a little snidely. A year and a half of dealing with the Korthans had been more than a little aggravating as I had been constantly surrounded by veiled—and often not-so-veiled—hostility. Juanth had been a major problem until he had been disciplined by his commander. Now it was a mutual balancing act, but bearable as he was reluctantly starting to accept my dedication to all aspects of my studies. Though I was still not in any hurry to take him on in a Challenge. Even Hinth still had to be reminded from time to time that we were equal partners. He had gone from a grudging junior partner cooperating only out of greed, to an equal partner who often tried to pass himself off as the senior executive. Only the fact that I was an alien had made it possible for him to cooperate with me as fully as he was.

Across the room, Drinth and Hinth were mirror images of neck-twisting as they tried to understand what we were saying, but naturally neither spoke English.

"How about giving me till the end of the semester?" I asked, explaining that it would take until then to recoup and reap the profits of our investments to expand the business.

Zach shook his head. "Afraid not. But don't worry. Your job is done. The

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Korthans are sorry they insisted on that little detail! But they definitely want to trade with us—they need the new markets—"

"They just don't want me trading here and shaming them," I finished. "What do they expect? That I just give up my investments and lose my pending profits?"

"Well, the Academy is going to graduate you both with Honors and buy you both out—"

"At current market value, or predicted fiscal year's-end value?"

Zach shrugged uncertainly and I turned to Drinth and repeated the question in my most forceful and painful bark, seeing Hinth jerk upright in shock and Drinth tense.

"And I can't be forced to accept your offer," I warned, suspecting Zach wouldn't have been called in if I could just be shut down. "Hinth and I have documented earnings projections, which we have kept deliberately conservative. It includes my projected buy-out figure, and Hinth's would be equal to that."

As I explained what we had planned, Drinth looked ill. Hinth looked briefly uncertain, but he didn't need a diagram to figure out what was happening and drew himself up to face Drinth.

"That is correct," he emphasized. "We are equal partners."

Drinth's fangs glimmered briefly as his jaw tensed, but then he hunched forward. "Very well. Give us your access codes and we will review your projections—"

"You will accept them," I barked. "There is no reason for them to be inaccurate as we both were protecting our profits in formulating them." I was risking an insubordination charge, but I also knew that I had a momentary advantage, and I had to take advantage of it.

Drinth jerked back as if slapped and came out from behind his desk angrily. I just gave him the formal Korthan Challenge Response bow. A cadet was forbidden to challenge a superior officer, but Drinth had made the first move, and if he wished to fight me . . .

"Do you wish to challenge?" I asked sharply.

I had learned a lot since that first painful bout with Hinth and I wasn't worried. Drinth would soon be losing his job anyway. He was getting too old and physically weak to survive many more challenges.

He froze, mentally picturing the consequences of a female cadet defeating him in front of two witnesses.

"No." For a moment he stood there, and then he went back behind his desk and made several sharp entries on his data terminal.

"You will both be bought out at predicted fiscal year's-end value—"

"And graduated Honors?" I pressed.

Never had the old expression about 'if looks could kill . . .' been more true. Even if I had not learned to read Korthan expressions I would have been more than a little nervous. But I was on a roll and I couldn't afford to stop.

Hinth, who originally had looked like he wanted to melt through the floor, was also leaning forward aggressively—unaware of just what was going on but quick to realize he'd better take advantage of it.

Drinth was deathly silent for a moment and I forced myself to stand firm. But finally he relaxed.

"Terms confirmed." His fingers flashed on his terminal again until he finished with a final harsh stab on the enter key. A printer spat out two copies of a contract which he handed over to us with obvious reluctance. As my copy simply stated that "Marie Dupree will be graduated Honors Status 6th Month/4, and her share of Pyramid Projects, Academy, will be bought out for an Earth equivalent of 2,500,000 exchange Units." I signed it with a flourish with a pen from Drinth's desk. 6th Month/4 was today's date and I smiled. Drinth's official letterhead and signature were a guarantee. Then I handed the contract

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to Zach to sign as a witness. Hinth happily followed suit since his contract was equally unequivocal. There was no room for lawyers on Korth since no one had patience for fancy contracts here. Any disputes were simply settled with a Challenge.

"You will be expected to vacate your quarters by day's end," Drinth barked as he made a copy of each contract for us and then made several more entries on his terminal. "Your diploma will be sent to you, and the buy-out has just been deposited in your accounts. Dismissed." With that he pointedly turned away from us to face Zach. "An escort will be here shortly to take you and Dupree back to your ship. You can wait outside."

Then we seemed to cease to exist, and taking his cue I grabbed Zach by the hand and dragged him out to the waiting room followed eagerly by Hinth.

As the door closed behind us, Hinth stopped me to stand there solemnly. Then after a moment, he drew himself up. "Marie: I give my Honor." Then he gave me a ceremonious bow of subordination—an incredible concession for him. "I wish you luck on your home world." Then he disappeared.

"That's it?" Zach stared after him. "You make him a fortune equal to tens of millions of Earth dollars, and he just says 'thanks' and splits?"

But I looked at the doorway that had swallowed him and I felt a little sad as I realized that I'd miss his canine overbite and constant expressions of wonder as I told him about Earth and our ways of life. Then I hugged Zach's arm and sighed.

"You don't realize what it took for him to bow . . . Never mind. I'll explain later." I squeezed, and then let go of Zach to squat on a chair to wait for our escort. I couldn't wait to get back to Earth—and proper recliner lounge chairs! Suddenly I was tired, as if the hard work and tensions of the past year and a half were suddenly piling up on me again.

Zach chuckled ruefully. "You do realize the Academy is going to shut down your little pyramid scheme—"

"Hah!" I shook my head and chuckled. "Ever hear of Pandora's Box? They'll never stuff my ideas back in the box. These girls are ready to *party*! They just needed someone to show them how. No, I'm afraid the guys here are in for a few changes at home."

Zach looked a little nervous and I reached over to pat his hand.

"Relax. You'll get your trade pact and Jump Gate Syndrome cure. There's going to be too much pressure for contact and new markets to resist. And as for us, I just have to make a stop at the bank before we leave." I grinned as I pictured the expression of the bank manager when I arranged for my new balance to be transferred to Earth as one of the first financial transactions between our two worlds.

The celebration dinner on the cruiser that was Zach's transport had been wonderful and I felt incredibly stuffed as I took a long, luxurious hot shower and relaxed. And I tried not to get too excited as I thought about a knock I would soon be hearing on my door. The ship's first officer, Paolo Cardenas, had been a wonderful dinner companion, dancer, and a fascinated audience for my tales of Korth, and soon he would be giving me a taste of something else that I had been missing for nearly three years because of Takeda's strict training and my subsequent Academy stint. But first I had one last thing to take care of.

After drying off and putting on just a hint of make-up, I wrapped myself up in a robe and settled down at my terminal to record a message for transmission when we got close enough to Earth.

"Dear Ms. Hansen," I began, "as per our agreement, I am notifying you of the successful conclusion of our contract on Korth. You can verify details through the SSA news-briefings which will soon be appearing on the Net. A complete description of my business program and its

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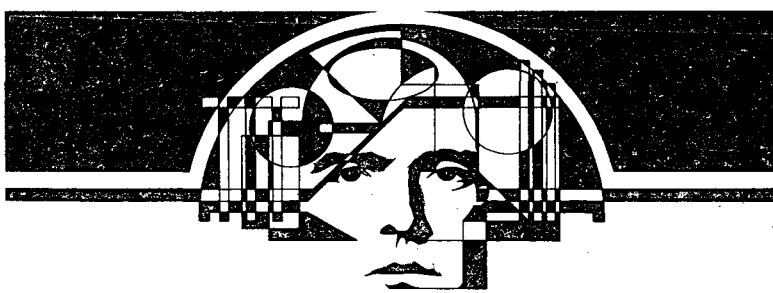
effects on the female Korthans is attached to this note. I expect the pass code to the bank deposits we agreed upon when I return to Earth. Respectfully yours, Marie Dupree."

I attached the business plan and results and then uploaded it to the ship's mail server with a smile. 'Why wait till the Academy', had been my thought when I had found out for sure what my assignment would be. I had waited until the very last moment when there was no way of changing any plans, and then I had set up a private—and carefully unmonitored—meeting with Marilyn Hansen, the head of the very well-financed Femme Coalition, and I had asked her bluntly: "How much would it be worth to your group for me to shake things up on Korth to start females on the path of empowerment? As opposed to my being very properly subservient and taking care not to intrude too much on the status quo."

After some indignant sputtering and charges of betraying my gender, we had settled down to some negotiating, with the final amount to be determined by the degree to which I affected Korthan society. As a tangible figure, we had settled on a modest cash amount multiplied by the number of women whom I recruited as independent business operators. I had only done a rough calculation of my final tally, but as I was at the top of a *very* healthy and wide pyramid—all documented in my attachment—I had already estimated that it was a very nice final amount indeed. Probably much to Ms. Hansen's regret. But if she squawked too much, I would just remind her that I had not included Hinth's downline or all the other females on Korth starting their own businesses—which technically were also due to my influence and subject to our agreement.

Then I heard a knock on the door, and I carefully let the robe fall open just a bit revealingly as I went to open it. I was looking forward to eventually tapping my new fiscal resources, but for the moment, some other rewards were best unquantified. ■



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Chat with Hugo-nominated author, **Michael Burstein**, Wednesday, September 15 at 9:00 P.M. (EST).

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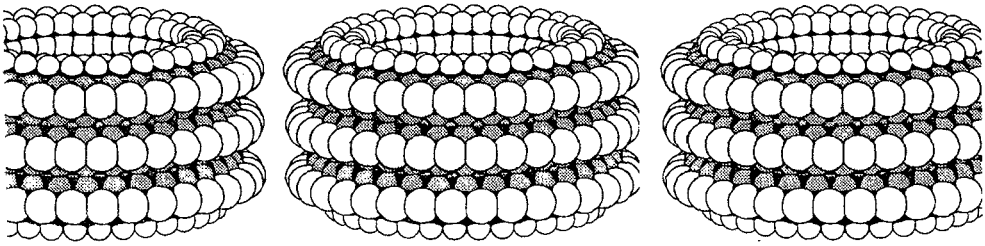
Stephen L. Gillett, Ph.D.

NEAR-TERM NANO-TECHNOLOGY



Well, I was wrong. Nanotechnology *is* developing, and it's happening faster than I thought it would. I attended the 5th Foresight Conference on Molecular Nanotechnology in Palo Alto last fall (1997), and a *lot* is going on. This conference is even becoming a mainstream meeting, with lots of university representation, not to mention the likes of IBM and Apple and a venture capitalist or three. (I even gave a paper, too; more on that anon.)

So, what's happening? That's the subject of this article—refracted, of course, through my own interests and expertise. I'll talk about some of the implications, too, especially those we're liable to see in the next few decades or so.

Assemblers, Scanning Probe Microscopes, and Self-Assembly

Nanotechnology (or, more fully, *molecular* nanotechnology, affectionately "MNT"), as all *Analog* readers know, is the atomic-level structuring of macroscopic objects: "A place for every atom, and every atom in its place."

The problem, though, with treating atoms as Legos is putting all the atoms in their places. Snapping Legos together is easy, and there aren't so many Legos in an object that you can't build it in a reasonable time.

Neither is true of atoms. Although we have embryonic technologies for moving individual atoms around, with so-called scanning probe microscopes (scanning-tunneling microscopes or STMs, atomic-force microscopes or AFMs, and others less familiar), we can't move atoms or molecules routinely yet. Preparatory techniques still consist largely of trial and error; images are difficult to interpret; and you can't routinely pick up a particular molecule, even when you can image it stuck to the substrate. You can't even routinely return to the same spot on the substrate!

Even if you could move molecules routinely one by one, though, it wouldn't be much help, because it would take a significant fraction of geologic time to build a

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macroscopic object. There are a *lot* of atoms in a typical object; roughly 10^{25} H_2O molecules in a glass of water, for example.

Practical nanomechanical synthesis must be massively parallel, as is traditional chemical synthesis. That means you must be placing lots of atoms at the same time.

I've suggested "molecular looms" as an interim measure. Soon it should be possible to fabricate arrays of micro-AFMs by conventional microlithography. If these arrays can be big enough (say 1000 x 1000), you may be able to move enough atoms to do something useful. Sure, it still has to be something that requires minuscule numbers of atoms. After all, if you move a million atoms a second nonstop for a year, that's still less than 10^{14} atoms—which, in the case of water, is less than a trillionth of a gram. But that may be enough for a few applications. Sculpting perfect catalytic sites, say on surfaces, is one. Since a single site can catalyze the reaction of a vast number of molecules, you don't *need* a huge number of sites. In fact, the "active sites" on present-day catalysts (of which more below) are no more abundant and a lot more haphazard. Still, though, that's a pretty limited subset of applications.

Such considerations have motivated lots of discussion about molecular assemblers. These would be nano*machines*, with molecular-sized moving parts capable of atomic assembly. But building *one* nanomachine gains you very little. You need trillions upon trillions, working in parallel, to assemble enough atoms in a short enough time to be useful. So (in the conventional paradigm) the nanomachines must be capable of self-replication; that is, of making copies of themselves. By the miracle of exponential growth, you can then obtain the 10^{20} or so you need.

As this is exactly what life does already, we have a proof of concept. The difficulty is that it's a *very* hard problem, or rather set of problems. It's bad enough to try to build a single nanomachine; to make it also capable of self-replication is immeasurably more complicated.

So, we must have a molecular assembler to have full MNT; but we must have full MNT to have a molecular assembler! This is the dilemma on whose horns nanotechnological development is thought to writhe. This dilemma is especially aggravating because the molecular assembler is vastly more complex than so many of the useful things it could build. Nanostructured materials, with atomic perfection but with no molecular moving parts, have scores of valuable potential applications: perfect crystals for optics and nanocomputers; molecular sieves and semipermeable membranes, for pollution control, purification, resource recovery and desalination; flawless fibers for superstrength materials; the list goes on and on. Do we *really* need a full-blown assembler to make *all* such items? Surely there's another way.

Self-assembly. And there is, for at least an interesting subset of the things we'd like to build: molecular self-assembly. Take some well- chosen building blocks—carefully chosen molecules with the proper shapes to fit together, and reactive sites to bind them when they do—and shake them together so that they assemble automatically into whatever it is you wanted.

Phrased like that, it sounds preposterous! If you shake a bucket of Legos, they don't spontaneously assemble into a model. But in fact molecular (and atomic) self-assembly is widespread in nature.

Crystallization is one example. Stir a bunch of atoms or molecules together; and not only do they stick together, they spontaneously arrange themselves into highly symmetrical, indefinitely repeating patterns. Or at least they do if their average energy—i.e., their temperature—is low enough. Frost forming on a winter night, as water molecules spontaneously leave the vapor phase to arrange themselves in the ordered arrays of ice crystals; salt precipitating from evaporating water, as sodium and chloride ions coalescing from the thickening solution

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to array themselves like bricks in a wall; feldspar crystals nucleating in a cooling magma; the examples can be multiplied indefinitely. Almost any substance will crystallize under the proper conditions.

Another everyday example is a soap film. The soap molecules automatically array themselves at the surface of the water, because that minimizes the forces on them.

More complicated examples of self-assembly exist, too. The tobacco mosaic virus is a spectacular example. Like all viruses, it consists of a sheath of proteins around a core of nucleic acids, and it can be disaggregated by certain mild reagents or by heat. But if the constituent macromolecules themselves haven't been disrupted, they will spontaneously reassemble into a virus when conditions change.

In fact, molecular self-assembly pervades life, from the intricate autoconstruction of a cellular membrane to the specific key-lock fits that give enzymes their extreme selectivity to carry out only specific biochemical reactions.

All this seems utterly counterintuitive, particularly when you consider that molecules collide *hard*, too. At room temperature, for example, the molecules in air are moving at speeds around a kilometer per second. Of course, they don't go very far, on average, before hitting something else. In air, this so-called "mean free path" is only about a hundred nanometers, and in a denser fluid like a water solution the path is even shorter. Yet somehow out of this chaos of randomly colliding particles emerge highly ordered molecular structures.

This bizarre self-organization is due to the enormous (and highly non-linear) forces between atoms and molecules. The highly organized crystalline state represents a low-energy configuration, an arrangement in which the forces between the molecules or atoms are meshed as well as possible—attractions maximized, and repulsions minimized.

Those forces are all ultimately electrical in nature, of course: they represent electrostatic interactions as mediated by the laws of quantum mechanics. But the forces are so complex, and have such different characteristics, that it's useful to split them up. Hence we speak of "ionic" forces if simple electrostatics prevail, "covalent" forces if the electrons are localized by a quantum-mechanical potential well, "van der Waals" forces for weak intermolecular forces resulting from fleeting induced polarizations, and so on and so forth.

(By the way, the seething thermal storm at the nanoscale, coupled with the enormous forces that operate there, are major stumbling blocks in intuiting the molecular world. The macroscopic world is not like that! When we sketch molecular or crystal structures, with their regular geometric arrangements, we tend to think of them as rigid. In fact, though, such structures aren't static; they're actually writhing with thermal motion. One advantage of animated computer simulations of molecules is that you can actually *see* this. Such simulations have given new insight into the operations of certain catalysts, too, by showing how fluctuations in the geometry around the catalytic site let certain molecules in.)

What about entropy? We hear a lot, especially in popular expositions, of Nature's inexorable tendency to disorder. And sure, entropy exists and must increase in spontaneous processes. But the notion that you sometimes hear, that *matter* must inevitably approach a state of maximum disorder, is simply wrong.

The reason is those enormous intermolecular forces. In such cases the position of "thermodynamic equilibrium"—the locally most stable arrangement—corresponds to a tradeoff between disordered arrangements and the energy differences among those arrangements. This is usually *not* at maximum molecular disorder. Only when the forces between the atoms or molecules are small, as with a dilute gas at moderate temperatures, does

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the tendency to disorder prevail. (A textbook example is the spontaneous mixing of evaporated perfume molecules from an opened bottle into the air.)

Instead, the interatomic forces are usually large enough that ordered phases—that is, self-organized crystals—are present at equilibrium. Cool molten rock, and watch silicate crystals form spontaneously at a certain temperature. Evaporate a brine, and watch salt crystallize spontaneously when a certain threshold concentration is crossed. Cool water, and watch it spontaneously organize into ice when it cools enough.

Here's a homely analogy for why disorder need not prevail. Fill a plastic bottle half full of water, and into it put a dozen or so steel balls and an equal number of cork balls. Now cap the bottle and shake vigorously. No matter how hard you shake, when you stop, all the cork balls will remain at the surface of the water, while all the steel balls remain at the bottom. The reason, of course, is that forces acting on the different balls are so different that their energy in different places (sunk on the bottom vs. floating on the surface) is *very* different. So, they have essentially zero tendency to become mixed up. (The spontaneous unmixing of oil and water is a molecular-level example of the same phenomenon.)

Thus, if we choose our molecular building blocks right, we can have them "crystallize" into molecularly ordered arrays. We can even conceivably change the composition of the arrays; lay down different layers of molecules at different levels, for example. And sure, there's a *huge* number of structures that we can't make with self-assembly, but could with a molecular assembler. But self-assembly's a *lot* simpler, it's a start, and it does promise some of those Practical Applications in the near term. It now has an exploding literature; check journals like *Langmuir*, or *Surface Science*, or *Chemistry of Materials*. (And yes, it's currently a research focus of mine, too.) Most of the research focuses on self-assembled two-dimensional arrays, so-called "self-assembled monolayers"; SAMs for short. Like a soap film, they're organized at a surface. Extending into three dimensions is harder; but research is happening there, too.

Nanotech, Resources, and Pollution Control

"A pollutant is just a misplaced resource."
—Anonymous.

A single, fundamental technological problem pervades much of engineering: the separation of one kind of atom (or molecule) from an arbitrary background of other kinds. Looked at in one way, this is the fundamental problem of extractive metallurgy; we have a natural feedstock (an "ore") that contains an economic amount of a particular element we want, and we need to get it out. (What's "economic"? That's determined by extractive costs versus the demand; and *both* are fundamentally determined by technology.)

But viewed in another way, this is also the problem of pollution control or purification. The only philosophical difference is that now we *don't* want what we're separating out.

Or at least we usually don't. But one paradigm shift due to MNT will be that the distinction between a "resource" and a "pollutant" will become fuzzy. In fact, MNT will totally revise everything we thought we knew about resources. And, as I've described before ("The Environment, Technology Drivers, and Nanotechnology," *Analog*, November 1994), environmental applications are likely to drive the development of these technologies.

Now, it's widely thought that element extraction is a fundamentally expensive procedure, and quite a number of the "doomsday" scenarios accept that assumption implicitly. For example, SF author and editor Darrell Schweitzer has stated in *Analog* (Brass Tacks, February 1998): "One day *all* the petroleum,

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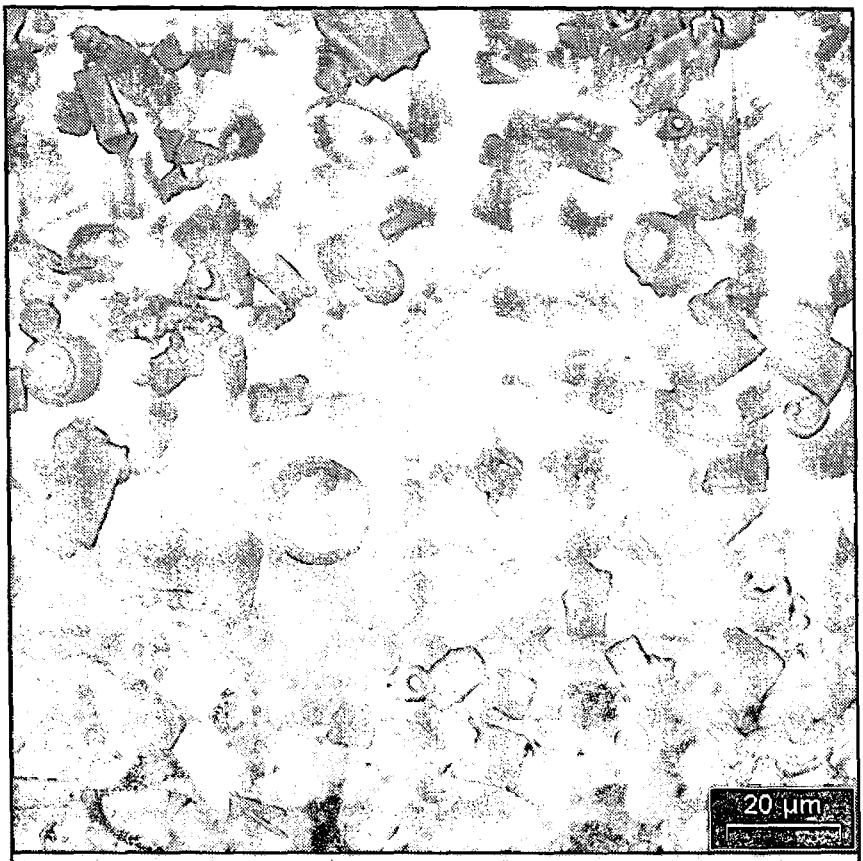

Diatoms (*Melosira granulata*) from the Pliocene of western Nevada. A diatom is a single-celled water-dwelling plant that constructs a shell essentially made of a silica (SiO_2) glass. To do so it extracts dissolved silica, which is present at levels of a few ppm in its aqueous environment, molecule by molecule. *(SEM photo by author with assistance of L. Grasseschi, University of Nevada, Reno.)*

gold, zinc, etc. will be extracted, and unless someone can make more, there will be no more." (italics his)

But gold and zinc (and other elements) are not consumed in the sense that petroleum is. They are *dispersed*, not destroyed. So, Schweitzer's implicitly assuming that it's then fundamentally, prohibitively expensive to gather the Au, Zn, etc. atoms back together again. However, as biosystems routinely extract elements at low ambient concentrations from the environment (consider the diatoms in Figure 1), it is obvious that this assumption can't be true.

The thermal paradigm. In fact, as I've belabored elsewhere ("Beyond Prometheus," *Analog*, December 1993), it's easy to show that the true cost of element separation is a couple of orders of magnitude below the energy costs of conventional extractive metallurgy. This is due largely to the reliance of traditional metallurgy on enormous flows of heat; on melting, freezing, boiling, condensing, often in repeated steps. One of my favorite

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examples is the pyrometallurgy of zinc. Zinc sulfide (the mineral sphalerite) is first "roasted" (burned in air) to convert it to oxide:

$$ZnS + 1.5\ O2 \rightarrow ZnO + SO2.$$

(A wasteful first step, by the way. Thermodynamically it is possible to oxidize only the sulfur. In other words, we *ought* to be able to use the sphalerite as fuel and get metal as a by-product!)

The zinc oxide is then reduced to metal vapor (!) by carbon at high temperature:

$$C + 0.5\ O_2 \rightarrow CO\ (vapor)$$

$ZnO + CO \rightarrow Zn(vapor) + CO_2$ (1000°C!). The zinc vapor is condensed to separate it from the CO_2, while any silicate impurities form a liquid (a "slag") that is left behind.

Yeah, it's simple. But calling it "profligate" in terms of energy is like calling a supernova "luminous."

Biosystems carry out considerably more spectacular feats of element extraction with considerably less sound and fury, and by using considerably less energy. Look again at the diatoms in Figure 1, for example. They extract dissolved silica (SiO_2) from the water to build those intricate shells. Silica is barely soluble in water; quartz sand hardly dissolves like salt if you pour it into water! The maximum solubility of silica in water is only a few parts per million. Nonetheless, the diatoms manage to extract it, molecule by molecule, from the water around them.

Other examples abound: Vertebrate kidneys, which filter only certain solutes out of the blood, all at body temperature; leaves, which extract CO_2 from the air, where it's present at a concentration of only 320 ppm, and use it to build plant matter; and on and on.

How do biosystems manage these feats? Not by extravagant applications of heat. By atomistic separation; by using biomolecular mechanisms that separate the dissolved components literally molecule by molecule.

Such biomimetic—"life mimicking"—approaches are exactly what nanotechnology makes accessible. We needn't even be as complicated as biosystems. Semipermeable membranes—molecular "filters" that allow certain solutes to pass, but retain others—already are finding wide use in pollution control, and nanofabrication techniques promise to make them both more robust and more reliable. (And this shows how the environment is becoming a technological driver. Meeting the standards for dissolved constituents in wastewater often requires advanced technology!)

Environment's the initial driver, because removal of an undesired component is what will pay the costs. Over time, though, as these new technologies mature and their costs fall, the distinction between a "pollutant" and a "resource" will blur. For after all, zinc that you extract from a wastewater stream is zinc that you don't have to mine. In fact, there are lots of noxious aqueous solutions out there, some of human origin—acid mine drainage, for one; and some natural, such as the hot, concentrated brines commonly associated with oil deposits. All these become potential resources.

I probably should mention that over the last few years I've put my career where my mouth is. Till a few years ago one focus of my research had been the potential for occurrence of a certain type of ore deposit, so-called "Mississippi-valley type" deposits, in the Basin and Range geologic province of western Nevada. Such deposits are primary sources of lead and zinc; but I have come to the conclusion that, far from becoming more precious in the future, they are going to become irrelevant. So I am no longer pursuing that line of research.

The obsolescence of petroleum. Darrell then goes on to say: "Chances are before that point [exhaustion of petroleum] comes, petroleum will be too precious a substance for anyone to dream of *burning* it . . ."

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This is also unlikely. However, it may well become *obsolete* before it runs out. Presumably Darrell is referring to the use of oil as a feedstock for the petrochemical industry, for plastics and such. Indeed, a professor of mine mumblety-mumble years ago made much the same comment, that petroleum was much too valuable as a source of chemically reduced carbon compounds to waste as fuel.

He (and I) both forgot that green plants make reduced carbon compounds routinely, using a diffuse source of carbon (the CO_2 in the atmosphere) and energy (sunlight)! If the natural nanosystems in plants can manage to make reduced carbon compounds from CO_2, surely synthetic nanosystems can too.

And indeed there's research to do just that. However, there is a much more obvious alternative source of reduced carbon: biological waste! Sewage, agricultural waste, timber slash, fermentation dregs, feedlot manure . . . a whole host of noxious waste products whose disposal is currently both expensive and inadequate. In fact, the petrochemical industry is fully aware that the days of abundant oil as a chemical feedstock are numbered, and they are already investigating biowaste as an alternative (Spitz, 1988; also a personal communication from a technical person at a Big Oil Company.)

Indeed, it's merely historical accident that we rely on petroleum as a chemical feedstock. It derives ultimately from 19th century efforts to use coal tar, a noxious waste (!) from making coke from coal. The efforts were spectacularly successful—they laid the foundation for the modern chemical industry—and they were later readily adapted to oil.

But why should oil become obsolete? Because it's hard to get. At present, we have a *very* expensive infrastructure, paid for by the value of oil as fuel, for finding and extracting petroleum from kilometers deep in the Earth. That infrastructure is likely to become considerably less cost-effective if the oil is merely to be used as a source of reduced carbon.

Indeed, this reduced-carbon-finding infrastructure coexists with other very expensive infrastructures to destroy (!!) reduced carbon compounds as fast as possible: the sewage collection and disposal systems throughout the industrialized world. Aside from its infection hazard, the main deleterious effect of sewage dumped back into streams is its "biological oxygen demand" (called—yes—"BOD" by geochemists). Because it *is* chemically reduced, it gets oxidized by microorganisms, and that uses up the oxygen in surrounding water. So we're oxidizing one set of organic compounds, even as we're extracting others at great expense from the bowels of the Earth . . . it's astounding the degree to which the irony goes unremarked, even in SF.

Of course, the obsolescence of oil must imply, as Darrell concludes, that ". . . other energy sources will be in use." Solar powersats have been my favorite candidate for some years, but there are a number of alternatives. Thus petroleum will prove to be as ephemeral as whale oil—useful, even critical, at a certain (low) level of technical sophistication, but laid aside as cheaper and cleaner sources come on-line.

Catalysts. As I said, these are another obvious near-term application of nanofabrication techniques. Catalysts, of course, expedite certain chemical reactions at the expense of others; and the better the selectivity for the certain reaction you want, the more valuable the catalyst. Selectivity minimizes byproducts and purification hassles; which means it minimizes expense, a fundamental consideration in industry.

Current synthesis techniques leave a lot to be desired, though. Often it's not really clear what, exactly, is causing the catalytic activity. The "active sites," where catalysis occurs, commonly seem to be things like atomic dislocations or defects on the catalytic surface, or adsorbed atoms, or some other anomaly. There's little control over their occurrences, and essentially none over their structures.

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So, the synthesis procedures tend to be purely empirical, worked out by trial and error, and passed down as trade secrets. They aren't *quite* at the level of adding eye of newt under the light of a full moon, but even so . . . I'm told that in many cases one batch of catalyst differs enough from the next that the chemical processes have to be adjusted for each new batch.

It would really be nice to (a) understand exactly what the molecular-level mechanisms of a given catalyst is and (b) fabricate it precisely! These are not just academic questions, either. There are literally billions of dollars involved.

The Obsolescence of Metals

Rivers of metals, byproducts of cheap, biomimetic extraction: sell your metal futures short! In 1980, biologist and pessimist Paul Ehrlich made a bet with economist and optimist Julian Simon concerning the price of a basket of commodities, mostly metals, in ten years. Ehrlich bet on a price rise, whereas Simon bet on a fall. Simon won, though of course Ehrlich has rationalized away his loss. I think, though, that we can now see what technologies are going to drive commodities prices ever lower. It's ironic, then, that metals may be becoming superabundant just at the point we may not be wanting much any more. For they're *weak*! Certain brittle materials are potentially far stronger.

But brittle materials are also far more vulnerable to microflaws. The reason is that a flaw concentrates stress and so tends to localize cracks. Then, once a crack forms, it localizes stress at its tip and so tends to grow.

Or at least it does if the material at the crack tip can't flow. Metals can deform—"undergo plastic flow," as the materials scientists say—and so cracks tend to heal, at least for relatively low stress levels. But brittle materials can't flow plastically. So a crack propagates, and the material fails catastrophically. A dropped water glass shattering on the floor is a familiar example. (Such analysis is generally associated with the name of Griffith, who wrote some key papers back in the 1920s, so you'll see references to "Griffith cracks," the "Griffith criterion," and so on.)

Of course, here in the Paleotechnical Era we can't fabricate materials without enormous numbers of nanoflaws: grain boundaries, crystal imperfections, nanonicks, microbubbles, etc., etc., where cracks can start and grow. So we use metal—because it works passably despite its flaws.

The fabrication of essentially flaw-free materials, by molecular assembly methods, will allow the great strength of brittle materials to be exploited routinely. And probably within the next generation.

Silicates and nanotechnology. As many *Analog* readers no doubt know, the favored nanotechnological building material is diamond; that is, a 3-dimensional carbon-based structure in which each carbon is linked to four others. It's a quintessentially brittle material whose theoretical strength is virtually the greatest known. Other carbon-based structures are also possible, though, as with the buckytubes I describe below.

But there's an alternative to carbon, one that is likely to do more than anything to transform the paradigms of resources. Silic*ates*, compounds based on silicon and oxygen, are a promising basis for MNT. (This, by the way, was the talk I gave at the Foresight meeting.) These elements can link together, through disiloxy (Si-O-Si) bonds, to form three-dimensional structures, and a number of these structures, such as quartz and feldspar, are familiar as minerals. Although not so strong as C-C bonds, the disiloxy link is remarkably strong by everyday standards; even with crude, present-day techniques, silica fibers stronger than steel have been fabricated.

And the clincher: the Earth is *made* of silicates. Nearly all common minerals are silicates. Rocks are silicates. Dirt is

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silicates; even the dust that settles out on your desk is largely silicate.

Ordinary dirt a resource, a resource more valuable than steel. Paradigms will have changed indeed!

MNT and Space

Over the last two decades or so a consensus image of Our Future in Space seems to have evolved among people seriously interested in such things. One common ingredient is the asteroid miner. It's even become an SF cliché; think of all those wealthy Belter civilizations, holding Earth economic hostage to their treasure troves of high-grade steel and strategic metals. . . .

And it's a scenario that's starting to seem as quaint as the slide rules and vacuum tubes in the classic SF from the 40s and 50s. Nanotechnology rearranges a great many paradigms for how we do things, and nowhere will paradigms shift more drastically than with space.

For consider: if you have cheap element separation; if you can extract metals from aqueous solutions at parts-per-million levels, who needs a metallic asteroid? And after my discussion above the strength of materials: who wants Fe-Ni steel anyway? "Structural metal" is likely to strike our descendants as an oxymoron!

Mining asteroids—or the Moon—is no longer a reason to go into space.

It's true that energy may still be. I remain fond of solar power satellites, and I now expect energy to be the only tangible space resource for use on Earth. Note, though, that the energy profligacy of current technology largely results from its reliance on heat, as in the conventional extractive metallurgy described above. We didn't have the "energy" crisis; we had the "heat" crisis! So perhaps energy isn't *quite* so critical as we'd thought.

MNT and Space Access. But MNT does much more than take away reasons to go into space. Overall, it makes it far easier to go there.

First, the extreme strength/weight ratios possible with MNT are going to make even chemical rockets a good deal more practical; smaller; and lots cheaper. Tom McKendree's work at USC, for example, has shown that a chemically fueled single-stage-to-orbit (SSTO) the size of a station wagon is possible, given a diamondoid fuselage.

The big problem with space has been the extreme cost of getting to low Earth orbit, so that only large organizations can attempt it; this, of course, in turn makes space ventures extremely political. Nanotechnology promises to drop that cost vastly. Perhaps we won't be quite back to the pulp vision of the eccentric professor and his beautiful daughter building a spaceship in the back yard, but at least we'll be to a level considerably below that of a NASA or a Boeing!

Of course, once the access cost is way down, all sorts of "frivolous" reasons for going to space, such as tourism, become eminently practical. Sure, space must become more than a bottomless hole into which one throws money. But lots of things become possible if it's not so much money that has to be thrown. You can afford to experiment, to determine which applications are investments, and which are mere stunts.

And speaking of access costs: Skystalks and such become conceivable given those extreme strength/mass ratios (what a materials scientist calls "specific strength," by the way). Dr. Richard Smalley, who won the 1996 Nobel Prize in Chemistry for his co-discovery of fullerenes, gave a talk on measuring the mechanical properties of buckytubes at the Foresight Conference. Their measurements suggest a Young's modulus of about 1 TPa (terapascal). This implies a tensile strength of about 100 GPa (10^{12} dyne/cm^2), as large as estimated for pure diamond structures, but, with a density about 2 grams/cm^3, a significantly lower mass.

Such a buckytube has a support length—the length of cable that could

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hang freely, under one Earth gravity, without snapping—of over 5000 kilometers. This is within a factor of two of the "Fictionite" in Charles Sheffield's classic popular article, now nearly 20 years old, on skystalks to geosynchronous orbit. The "taper factor"—the ratio of the cross-section of the cable at geosynchronous orbit, where tensional loads are greatest, to that at the surface—of such a cable is less than 3, which is certainly reasonable.

What's a buckytube? Oh. Take a C_{60} molecule (buckminsterfullerene, the "soccer ball" molecule), cut it in half, and stitch in a new ring of carbons between the halves. Stitch in *lots* of new rings, in fact. The molecule then becomes elongated into a tube—a buckytube. And there's no theoretical limit to the elongation; conceptually, anyway, you can put in as many rings as you want.

Another conceptual way to make a buckytube is to consider a single sheet of graphite, which consists of a two-dimensional hexagonal array of carbon atoms. Snip out a long strip of the sheet, roll the strip up into a long tube, and fasten the sides together. You can now cap off the ends if you want.

Why are buckytubes so strong? Carbon is a light element, and four out of its six electrons are involved in chemical bonding. So relatively little mass of the atom is dead weight. Also, in the graphitelike structure of a buckytube, the bonding electrons are "delocalized"; they are shared across many atoms. This strengthens the bonding, because the extra electrons give the bonds some double-bond character.

The fibrous nature is also a help. If a buckytube *does* crack, the crack can't go anywhere. It can't propagate across the stalk, but must stop at the edge of the buckytube. This significantly increases the safety factor, a major issue in something as big as a skystalk!

What about even stronger materials? Actually, since the figure of merit we want to maximize is the specific strength, decreasing the density is as desirable as increasing the strength.

Unfortunately, either seems very hard to do. You could gain a tiny bit by making the tubes of pure carbon-12, the lighter stable isotope of carbon. However, that lessens the density by less than 1 part in a thousand, since ^{13}C, the heavier stable carbon isotope, only makes up about 1% of terrestrial carbon. So the gain's probably negligible.

Boron nitride (BN) makes analogous structures to carbon. You can think of a boron-nitrogen pair as replacing 2 carbons, since a boron atom, with 3 valence electrons, and a nitrogen, with 5, have the same total number of valence electrons as two carbon atoms (each with four). There is a BN analog of graphite and even one of diamond (which is marketed as the synthetic abrasive Borazon.)

Unfortunately, a boron nitride buckytube has no mass improvement over carbon. The lightest stable isotopes are ^{10}B and ^{14}N, so a $^{10}B/^{14}N$ pair masses just as much as 2 ^{12}Cs. However, for quantum mechanical reasons I won't get into, BN is a non-conductor, and that may be useful in some applications.

Perhaps boron carbide compositions could reduce the mass some, but then the chemical bonding gets iffier, since boron molecular structures tend not to be linear but to curve back on themselves. And even so, the gain would be only a few percent at most, as even a pure boron structure would yield a gain of less than 10%.

Buckytubes will work. Indeed, I think we now know what Dr. Sheffield's "Beanstalks" are going to be made of. True, there are some minor fabrication issues: the tubes that Dr. Smalley measured were only about 5 nanometers long. So, all we need to do is to be able to make *lots* of buckytubes, in lengths of 50,000 km or so. . . .

Resources in space. As if to compensate for the irrelevance of space metals to Earth, MNT makes space-based resources for use *in space* considerably easier. The

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reason is, of course, cheap element separation: just as on Earth, anything becomes a potential resource.

There's a certain irony here: A number of naïve space popularizers in the 80s and even into the early 90s touted the regolith covering the lunar surface as "demandite," because it contained a selection of chemical elements in roughly the proportions used by industry. But the lunar regolith is just pulverized rock, very similar in composition to terrestrial rock. So, why was common rock "demandite" on the Moon but useless on Earth—where, moreover, a sophisticated industrial and transportation infrastructure already existed? In fact, the sort of extractive metallurgical processes proposed for the Moon would require ores, just as on Earth (and as I argued many years ago in this magazine ["Mining the Moon," November 1983]).

But with sophisticated molecular separation technologies, regolith may indeed become demandite; but hardly for terrestrial use! In fact, regolith may be better than demandite. Being rock, it's largely fine-grained silicate debris—and a better potential feedstock for a *silicate*-based MNT is hard to imagine. Quartz cities on the Moon by 2050? It's more conceivable than I would have thought.

Of course, carbon MNT structures are still stronger. There's little carbon on the Moon, but quite a bit in certain kinds of asteroids: the so-called carbonaceous chondrites, which are already of wide interest as potential sources of organic compounds for life support.

But the largest off-Earth reservoir of carbon in the inner Solar System is the thick CO_2 atmosphere of Venus. Scoopships mining Venus atmosphere for its carbon—that's not a scenario I've seen in SF!

Thus, MNT will also make building a space infrastructure considerably easier. That's been another issue, as the sheer hostility of other planetary bodies has sunk into our consciousness; there isn't even any water in lunar rocks! All that 50s and 60s vintage SF was considerably more optimistic than the reality. Life support also becomes considerably easier, and maybe even possible in something the size of a space colony. After all, the biosphere can be regarded as a terrestrial self-maintaining, nanotechnological life-support system.

Perhaps there's an alternate universe in which all those 50s and 60s visions came to pass; in which the passenger rockets lumbered to orbit and nuclear freighters plied their way to the Moon and Mars; in which skyjacks assembled orbital stations and miners sought ores among the asteroids—but it just isn't going to happen that way now. I, personally, blame the Vietnam War for derailing this extrapolation; not only did it take away all the money, but it delegitimatized large technological ventures at a critical time.

But, maybe, after all it was for the best. The way I put it now is that doing space without MNT seems like building Babbage's Analytical Engine without electronics. Sure, it could have been done, and Sterling and Gibson showed how it might even have worked; but it's extremely expensive, available only to large organizations (with all *that* implies for threats to individual liberty), and even so dreadfully cumbersome.

Molecular Assemblers: 2015 and Counting?

Passive MNT structures can take you a long way; nanostructures, membranes, catalysts; maybe even superstrong materials put together by self-assembly techniques.

But still, for lots of things you need a molecular assembler. Even *big* passive structures probably require active assemblers, 50,000 km of buckytube cable being one example.

Progress is occurring here, too. A start-up company, Zyvex, Inc. of Dallas, has been founded with the avowed goal of building a molecular assembler—and of making money in the interim. They

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feel that there are excellent prospects of spinning off marketable technologies on the way to assembler development.

Hey, I'm always impressed when people put their money on something. You think *scientists* are skeptical . . . try your friendly local venture capitalist!

At least to start with, the assembler is likely to work with molecules rather than individual atoms. Although that will decrease the flexibility, molecules are a lot easier to move. Being bigger, they aren't as affected by thermal vibration; they're easier to see; and they're a lot easier to pick up. But, of course, they're still atomically perfect.

And you could build a lot of things, with proper molecular building blocks . . .

Christine Peterson, the Vice-President of the Foresight Institute, has made a Moore's Law extrapolation that we should have molecular assemblers about 2015. (Moore's Law, of course, refers to the well-known doubling of computer capabilities every 18 months or so.)

That still may be optimistic; but since I expected more like 2050, it can be quite a bit later and still be sooner than I'd thought.

Toward a New Stone Age?

Stone (silicates) and wood (carbon composites) were the first construction materials humankind employed. But then along came metals, and we now tend to think of the Progress of Civilization in terms of the metals it used: copper, bronze, iron, steel; and now aluminum, titanium, tungsten, molybdenum, manganese . . . half the elements in the Periodic Table.

So it's doubly ironic to realize that perhaps metals, too, are a passing technical phase. With molecular nanotechnology, and the ability to fabricate molecularly flawless materials, metals will become far less attractive. Carbon and silicates, immensely strong though brittle, may become the construction materials of choice—even as the profligate use of raw heat, so typical of present technology, also dwindles away.

Fire and metal—the stigmata of the Paleotechnical Era? ■

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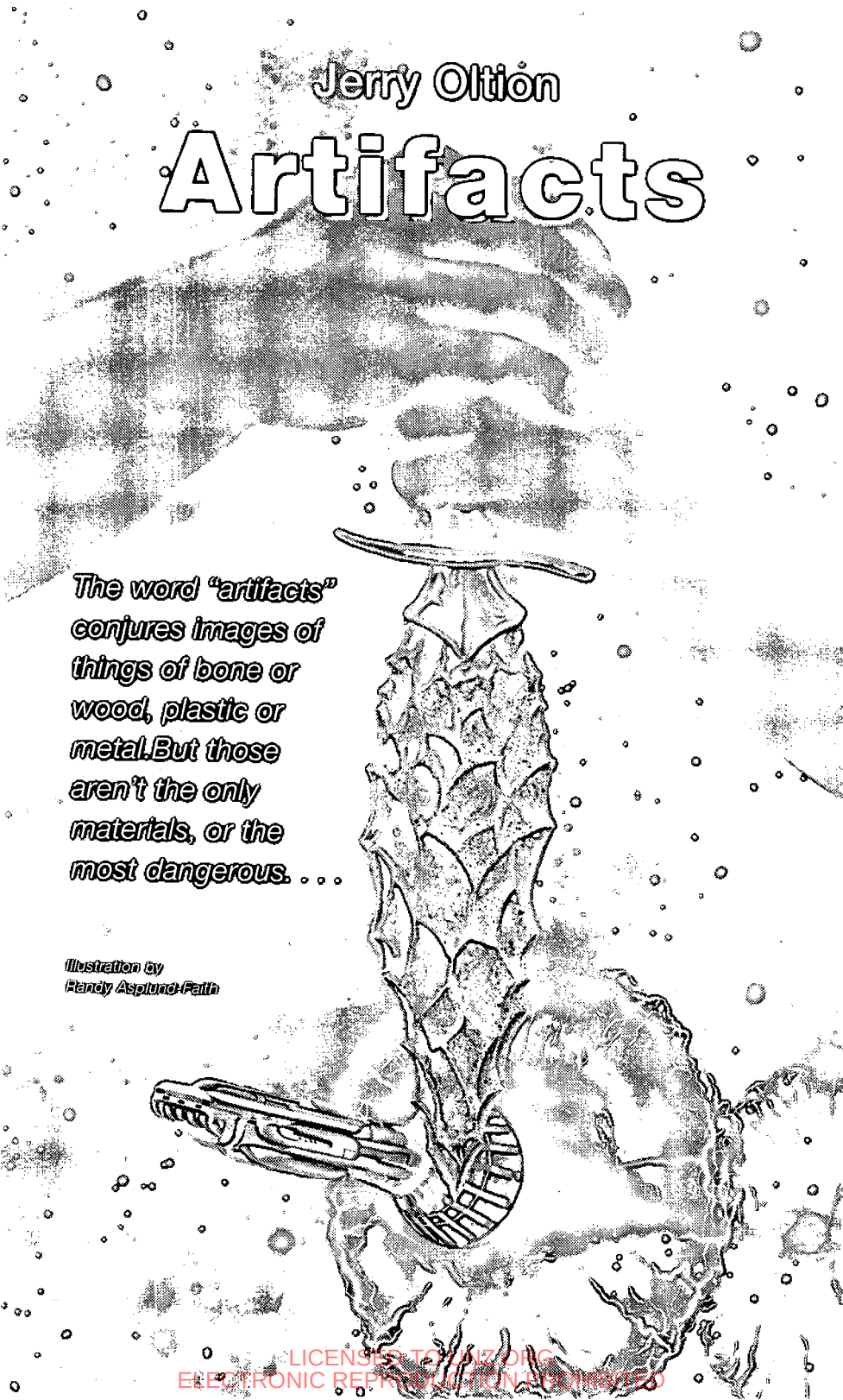
Jerry Oltion

Artifacts



The word "artifacts" conjures images of things of bone or wood, plastic or metal. But those aren't the only materials, or the most dangerous. . . .

Illustration by
Randy Asplund-Faith

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The worst part was the drowning. No matter how many times he did it, when the *g* pod began to fill with oxylene and Brian felt the warm, neutrally buoyant acceleration fluid lapping at his ears and then at his cheeks and finally at his nose, he screamed loud enough to wake the passengers in cryo. But it only echoed in his tiny sealed tank, and since his ears were already awash and gurgling he didn't hear it all that well himself.

"Good," the comp said, as it always said. "One more, please. Empty your lungs completely." He could hear that just fine, since it came in through the bone phone in his jaw.

He obliged it. No problem. By then the oxylene was up past his nostrils anyway, and there was only one thing to do. If he held his breath he would just choke longer.

So he screamed all his air away, flattened his lungs as much as possible, and then while his mouth was still open in that primal expression of terror . . . he breathed in.

Oxylene's density was the same as the human body, but it had the viscosity of starlight. The stuff slid right down. Plus it was supercharged with oxygen, so it hit like jet fuel. Brian gasped a whole lungfull in shock, blew most of it back out to splash against the curved wall of his tank, then sucked in another more normal breath. It tasted a little metallic, like water stored in an aluminum pitcher, but after a few breaths he hardly noticed it. The sound was worse. His pulse beat like a drum in his ears, and would until the acceleration was over and he could get out of the tank.

"Are you comfortable?" the comp asked.

He pinched his nose and blew the last of the air out of his sinuses through the shunt installed in his ear. He also belched and farted and blew bubbles out of a few other special orifices most people didn't have. He couldn't leave air anywhere inside of him. At five hundred *g*s, a gas pocket the size of a ping-pong ball could kill.

"Captain?"

His voice wouldn't work now that his throat was full of fluid, so he reached up through the warm currents and tapped the talker panel in front of him. It was an easy arm's reach; his tank was less than a meter in diameter. The panel had been above him a moment earlier. He hadn't moved, but up and down ceased to mean anything once he was afloat. That was the whole point of the tanks. He pressed the green "yes" button in the glowing panel and settled back for launch.

"Crew are secure," the comp told him. "Passengers are secure. Cargo is foamed." The passengers didn't get *g* pods. It was too expensive to do that for everyone, and too dangerous. Only the captain and his crew of four stayed awake during the trip. People who weren't needed on the way were frozen for transport, then sealed in dry ice bodymolds and slotted into cubbys. The cargo was just stacked and sprayfoamed into place. The boxes weren't going anywhere, and it was the shipper's problem if the internal packing didn't hold up to the thrust.

Brian pushed the "proceed" button on his panel, then lowered his arm to its rest. Theoretically it could have hovered over his head during launch, the oxylene holding it perfectly balanced, but he wasn't that trusting. A slight difference in density between the working fluid and his body, and his arm could suddenly weigh half a ton. Of course if there was an imbalance he'd probably die from internal hemorrhaging anyway, but he didn't want to slap himself in the face first.

"Launch in ten," the comp said. "Nine." And so on down to zero.

Then the hydrogen bomb went off.

The walls of his tank flexed under the stress. The lights that ringed the inside of it flickered. One burned out: Brian hoped that was the worst of the damage to the ship, but he could only see a

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small, unfocused oval of the control room through his tiny peephole. A big window would compromise the tank's strength too much.

There must not have been much else, however, because a few seconds later another bomb went off. Then another. And another. And another. Brian spent the time watching his life flash before his eyes, trying to force the subjective movie to dwell on the good bits. It never did. He got flashes of his schoolmates teasing him for believing in Santa Claus, and of ex-lovers telling him he wasn't adventurous enough for them.

If only they could see him now. Riding a bombship built partly out of alien technology—technology left for humanity like presents under a tree—and risking his life with every blast.

He felt the urge to pray. Years of indoctrination died hard, but he fought it down.

Fortunately the acceleration didn't last long. Within a few minutes the ship was moving at four percent the speed of light. Still a hundred years to Alpha Centauri at this velocity, but fast enough to cross the solar system in five and a half days.

They were going the other direction. Straight up out of the plane of the ecliptic toward Polaris. Only fifty AU, a mere fraction of the distance to the North Star, but even so by the time they got there the sun would be just a bright speck in the night behind them.

This was Brian's sixth visit in as many months. He was the person who had first set foot on the Artifact, and he'd been on every trip to it since, ferrying up scientists to study it. They had a fair sized team there now—fifteen people—and they were bringing seven more.

When the bombs stopped exploding, the comp said, "Acceleration complete. Are you ready to drain your tank now?"

He pushed "yes," and the oxylene slipped away as quickly as it had flooded in. Air jets forced the last of it out; there was no gravity now to help it drain away. He exhaled as much of it as he could in one breath, then coughed out the rest in involuntary spasms as his lungs filled with air again. When he recovered his composure a bit he said, "Open the door," and the computer popped the seal.

He had to push it away himself. Hydraulic machinery that could survive the acceleration would weigh too much, and would trap him if it failed. Bombships were built simple and rugged. The tank was small enough to brace himself in, so it was no problem to open the door anyway.

Fortunately there was plenty of power for hot water. He washed away the last of the oxylene in his zero-*g* shower, donned his bright blue captain's uniform, and bounced along the central corridor to check on the crew.

Marlene had already showered and dressed. She was wearing the green coverall of the general crew. Pierre was just emerging from his shower; he snagged a towel from his personal bin and floated in the air before them, toweling off without any trace of modesty.

"So did we lose anybody?" he asked, and in the same breath, "How much work have we got?"

Brian didn't see Sharrol or Dave, but the computer would have told him if anyone had died. Of course if any of the cryo passengers had shifted and broken, the crew wouldn't know until they open the cubbys, but that didn't seem to be Pierre's concern. He apparently just wanted to know if he'd have to do any extra work to fill in for anyone.

"We all made it," Brian told him. He wanted to say something about his attitude, but he didn't. They all reacted to danger in their own way. Pierre had been this way on the flight back home from the Artifact last month, too.

He nodded and took a green coverall from the bin. Sharrol and Dave came in while he dressed; they glistened from more than just the oxylene. They showered together, toweled each other off, and dressed, then the five crewmem-

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bers made their way out into the ship, looking for damage.

They found the usual broken equipment, but nothing more. Just enough to keep them busy with repairs while the ship coasted out to their destination. To Brian it seemed a hell of a way to fly, but when they were robbing technology from random sources they couldn't necessarily get a smooth marriage.

After repairs it was back into the tanks for deceleration. Boom, boom, boom, and they were at rest relative to the Artifact. They'd stopped two hundred thousand miles to the side of it, since they didn't want to use the main drive any closer than that, but from there it was a relatively easy jaunt across the gap. Like Earth to the Moon. Piece of cake.

Pierre piloted them in using a more conventional rocket engine. Brian watched through the porthole—a heavily reinforced window only a foot across, the biggest one on the ship—as they approached the Artifact. That was what the tabs had been calling it, as if it were the only one, but in truth the Solar System was lousy with artifacts. The place was four billion years old, after all, and the galaxy was full of life. Had been, anyway. It apparently came and went, usually on the wings of religion or warfare, judging by the records left behind. Explorers had identified fourteen separate waves of expansion, involving at least thirty races. All of whom left their garbage behind. And a few of whom left treasures.

This one looked like a treasure. It certainly looked alien enough to contain something humanity hadn't come up with on its own. It was mostly a spaghetti pile of tubes, each about fifty feet across with an occasional swelling to accomodate large machinery. Some of the tubes were habitat for winged serpentine monsters about ten feet tall (long dead, fortunately—or unfortunately, depending on a person's point of view), but the rest were just a warren of passages full of stuff. Like most artifacts, however, nobody knew what any of it was intended to do. They had learned with the Phobos station not to just push buttons at random, so the team studying this one was taking their time here, looking at things closely.

But even mistakes made in haste could have interesting consequences. Phobos made a much more beautiful set of rings than it ever had a moon.

The people they had left behind on their last trip were glad to see them again. A supply ship meant fresh faces, fresh equipment, and best of all, fresh vegetables. After six months on an isolated station, Brian had had people offer sex for a good crisp apple.

These scientists weren't quite that glad to see their supply ship, at least not overtly. Brian imagined that later on most of his crew would get lucky, but the dozen or so people crowded around the airlock when they arrived were all fully clothed and much more interested in showing off what they had accomplished since the ship was last there.

The lead xenologist, a small, energetic woman named Julie, shoved a U-shaped device into Brian's hands. A boomerang? No, it was a headset. A massive one. He recognized it from when he was there the first time, on his own and poking through the Artifact in a spacesuit with a headlamp. There had been racks of them in many of the rooms he had entered; they were one of the things that had convinced him this place would be worth investigating further. "Turn it on," Julie said.

"How?" he asked. She pointed at a rough spot on one side. He wondered why she didn't switch it on herself, but it looked simple enough so he pressed his thumb into the spot.

Suddenly he was flying through the air. For a second he thought the headset was pulling him through the airlock vestibule, but then he realized he wasn't even in the airlock. He was back on Rockaway Station, in Lunar orbit, skydiving down its ten-mile-long central

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axis in the nude. And he was female. She was exulting in the moment; everyone was looking at her. She commanded the attention of the whole colony. Soon she would command their lives. She reached up to cup her breasts seductively, and suddenly he was back in the Artifact vestibule, himself again. The motion of his hands had broken the connection.

The headset was a virtual reality generator. A good one—he hadn't even had to put it on his head—but nothing fundamentally new. Brian wondered at the program Julie had chosen to run for him; was this some new way to proposition someone? If so, shouldn't she have given it to Pierre? They had been practically inseparable on the last trip. But even if she was after Brian now, it hadn't worked. He was left with only a mild annoyance at her presumption and an uncomfortable feeling that he'd glimpsed something a bit too personal. Who would guess that Julie had an urge toward megalomania?

"It's polite to warn a person before you switch their gender," he said, handing the alien device back to her.

She didn't apologize. "Wasn't it great?" she asked. "The bandwidth is better than anything we've seen before. I think it engages the entire nervous system."

"How did you record it?" he asked. She obviously hadn't been on Rockaway recently.

"That's the amazing part. That was a memory. I just remembered it while the VR wedge was running, and it picked up all that detail."

He wondered what aliens from the distant past were doing with virtual reality equipment tuned to the human nervous system. He wondered how distant this particular station's past might be. All the others they'd found had been millions, if not billions, of years old, but people had always suspected that newer ones existed. Earth history was full of circumstantial evidence. "Have you established an age for any of this yet?" he asked.

Julie shook her head. "Not for sure, but it can't be very old. Most of the gadgetry still works."

"Then don't push any buttons while I'm here," he said. She laughed; obviously she thought he was kidding.

They formed a pass-it-on line from the ship to the Artifact living quarters. It wasn't as easy as on a human-built station. Normally you only needed to put one person at every corner and float things down the corridors from person to person, but here it was all curves so they needed people every few dozen feet. But they managed it, even pulling the new scientists out of their cubbys and stacking them in the on-site med freezer to await thawing. That would be a long process, and the warm bodies had already worked up a good appetite, so they left the others frozen for the moment and had their big welcome dinner.

"So what else have you found here?" Brian asked as they sat down in the half-*g* section of the rotating lifesystem. Most of the long tubes that made up the Artifact could rotate; they spun longitudinally, flexing like something alive so they could maintain their curved topology even while in motion, and they had frictionless collar-joints so different sections could spin at different rates. The investigators had only run a couple of them up to speed to use as a cafeteria. Humanity had adapted pretty well to zero *g* in the hundred years or so they'd been out in it, but people still liked a little gravity to hold down their food while they ate, and one thing they'd never discovered among all of the alien gadgets littering the Solar System was an artificial gravity generator. Nor a faster-than-light starship. The more they looked at the way the various aliens had lived and travelled, the less likely either one seemed.

Julie ticked off on her fingers the discoveries her team had made. "Yet another high-temperature superconductor, this one good up to twelve hundred degrees. An airgel packing foam stronger than solid steel. A polymer that we think

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was food when they brought it here, but it makes a great glue now. And the VR device I showed you. We think they're actually external memories."

"Not religious artifacts?" Brian asked.

She rolled her eyes and he grinned to show her he was kidding. Archaeologists used to claim everything from figurines to soup bowls were religious artifacts. It evidently sounded more interesting than the mundane truth. But when dealing with alien races, even the mundane could be pretty exciting, so they'd quit using the religious interpretation to mean "we don't know."

Besides, there were plenty of artifacts that obviously *were* of religious origin. Aliens were no different from humans in that regard. But if Julie had stumbled across any of those, Brian's ship would have carried a theologian this trip.

So he asked, "Were there any alien memories left in any of them?"

She glanced at one of the other scientists, and a flicker of communication passed between them. "Nothing comprehensible," she said.

Sharrol asked, "What happens when you access one?"

Again that brief eye contact, then the other scientist said, "When I tried it I spent a week staring at my navel before I came out of it. Anton disappeared into the warren and hasn't been seen since."

"You *lost* him?"

Julie shrugged. "There are fifteen of us. We searched as far as we could, but the rest of the station isn't heated or pressurized. He couldn't have survived long in there even in a spacesuit."

"Then you should have found him." Brian couldn't believe her attitude. He'd thought Pierre was the only one who thought that way.

A little testily, she said, "You're welcome to go have a look yourself if you want."

He planned to. The ship wasn't scheduled to return for a week; he wanted another look at the Artifact. He hadn't had a chance to poke around since he'd first come here, and he felt responsible for everyone's presence. If he'd said no, this would have been just another dead Outie station, it might have remained undisturbed for another geological epoch or two. But it was a new design, probably built by a new race, and it was full of nifty new stuff, so he'd called in the vultures.

Now he wondered if that was such a good idea. Nothing overt made him question it, but he'd learned to trust the back of his neck, and it was definitely tingling. Something didn't feel right about Julie's story. For one thing, neither she nor her companion looked like people who had spent a week in a coma after playing with alien tech. They weren't afraid enough.

After dinner he set out to find out why. Julie tried to keep him at the party, but he brushed her off and wandered the station. He explored the corridors that had already been pressurized first; no sense making himself uncomfortable until he'd seen what was close at hand.

The spaghetti tubes wound around one another apparently at random. They were filled with living quarters, storage rooms, open-air piles of machinery, and bare patches of dirty floor that might have once held living things. Paths wound through it all, and portals occasionally connected one tube to another when they touched. It would have been easy to get lost. The right-hand rule for finding one's way out of a maze would be useless there.

And so would any kind of search pattern Brian could imagine. Unless he stationed a watcher at every portal and examined the tube from end to end, checking every building along the way—a job for an army—a person could never catch someone who wanted to stay hidden. For that matter, Brian wasn't sure there was only one tube. Two of them coiled up in a heap would have looked pretty much like one.

The place was silent. Everyone else was off celebrating in the commons. Brian drifted along like a fish over a reef,

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occasionally pushing off with a finger or a toe when he approached a wall, or pulling himself inside a building when he got the whim to investigate something closer. He saw lots of ordinary alien stuff: benches and beds and tables were pretty much universal. He saw lots of incomprehensible stuff as well, but most of it looked pretty innocuous. Artwork, sculpture, maybe their equivalent of coffee makers. It was obvious that this was once living space for a lot of aliens; not just an outpost. He wondered if they'd been fleeing one of the wars elsewhere in the galaxy. Or maybe they'd been troops.

He found a few weapons. That wasn't disconcerting; every race they'd studied had weapons. These looked like simple microwave lasers—masers—though it took a moment to find the business end. These aliens had unusual hands. Brian resisted the urge to test fire one, remembering Phobos. But then he saw what was obviously a power gauge along the side of the emitter and he realized its energy pack was long dead. So the Artifact was at least old enough for batteries to drain. That would be about a thousand years if these aliens used the same battery technology found in other outposts. Julie must have had to recharge the memory gadget to make it work.

The tubes wound around and around each other, but after a while Brian realized there was a definite direction to them. It was a subconscious feeling, and he wondered where it came from, but he knew he was heading somewhere so he drifted onward, following the subliminal cues, and he eventually came to an amphitheater. It was in a section of the spaghetti tube designed to rotate for gravity; it wasn't rotating now, but there were benches arranged in semicircular rows. Brian wondered why the aliens hadn't put the amphitheater in a zero-g section where everybody could get a good view, but he figured whatever they watched here must have required gravity. It hadn't taken long, apparently; the benches looked uncomfortable. They were set farther apart than human design would make them, too, independent corroboration that these aliens had been bigger than humans. There was a dais down at the bottom with what looked like a stubby podium in the middle of it, but when he floated closer he saw it was a bed of some sort. It was designed for a ten-foot winged monster to lie down on—on its back.

Odd, he thought. Their limbs came out from the sides and bent downward like gila monsters', and their wings folded up behind them; they would have been almost helpless on their backs.

Then he noticed the gutters around the edge of the dais. For bathing? But he saw no water source. And the gutters didn't empty into a drain, but only into a basin. So whatever the fluid involved, there mustn't have been much of it.

Blood? The thought came unbidden, and suddenly with the clarity of a hallucination Brian saw a person strapped there, struggling as he plunged a knife into their chest. He flinched back, disgusted with himself, not just for the image but his reaction to it. For a second there he'd been excited.

He shook his head as if he could dislodge the image, and pulled himself closer to the table again. Trying to be charitable, he thought perhaps it was an operating theater for training medical students. A little examination revealed a shelf below the bed on the back side of the dais, where someone facing the audience could easily reach it, and floating behind a net to keep it in place he found a stone knife. Double-edged. Quite sharp. But not delicate enough for surgery.

They were hundreds of millions of miles from the nearest rock. There were much better materials to make a knife from anyway. Brian could only think of one reason to use a stone knife on a helpless subject in front of an audience, and he didn't like it.

Nor did he like the hundreds of headsets in a rack behind the altar. He gingerly

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removed one, avoiding the thumb-switch, and examined it closely. There was no way to tell what was stored inside, but he could guess. Either the memories of the victim or the memories of the congregation, and either one made his skin crawl.

Now that he held the device in his hand he saw a tiny amber light glowing from its apex. The power gauge read fully charged.

He flung it away with all his strength. It smashed against the wall above the farthest row of seats. Pieces of plastic, or whatever it was made of, sprayed outward and tumbled back into the room.

He snatched another one to send after the first, but he stopped with it still in his hand. How could it have power?

He looked at the others. The first twelve were lit. Counting the one he smashed, and the one Julie surprised him with, there was one for every person on board before this last supply ship arrived, but only if they had been activated after the missing scientist, Anton, disappeared.

Or maybe *while* he disappeared. Considering the flashback Brian had just experienced, that seemed pretty likely. He must have gotten that image through Julie's headset along with the memory of flying.

What else had she planted in his brain?

He heard a noise from outside, and immediately jumped for the ceiling. Nobody thought to look up when they entered a room, especially if they were busy. The amphitheater was in zero *g*, but it had been designed to be used in gravity, so maybe the subjective impressions would keep people aligned along the floor. Brian wished he was armed in case they didn't, but he he hadn't been expecting this kind of situation when he went for his walk.

The scientists entered the sacrifice chamber, Julie in the lead. The others held Sharrol and Dave. Brian saw no sign at first of Marlene or Pierre, but then he realized why: he was looking for them among the captives. Instead they were helping hold their crewmates, who struggled and shouted obscenities at them.

Brian had about two seconds in which to act before he lost the element of surprise. He did the only thing he could think of: kicked off hard against the ceiling and flew into their midst, turning over in flight so he struck feet first, knocking Pierre back. Sharrol kicked at the other person holding her and twisted away. More hands reached for her, but Brian grasped the door frame with his right hand and her hair with his left and yanked her free. They tumbled into the main tubeway, kicked off clumsily from the receding wall of the sacrifice chamber, and flew across the tube and through a portal into another one just as the back of Sharrol's green uniform tunic burst into flame. The science crew were using the alien masers.

Sharrol screamed and slapped out the flames, but the word she repeated over and over as they pulled themselves behind a building and Brian dragged her away was, "Dave, Dave, Dave!"

Brian tried to think of some way to break him free as well, but it was sixteen against two and the sixteen had the weapons. If he and Sharrol could make it back to the ship they could get their own guns, but even then it would have been suicide. Their only real option was to get away and go warn Earth what was out here.

It had always been a danger. Many people back home argued that people should never have exposed themselves to it in the first place, that alien technology wasn't worth the risk of importing alien ideas as well. Look what happened the last time an alien idea got loose, they'd said. Humanity was over two thousand years eradicating it, at the cost of billions of lives. And the concepts affected society forever.

In fact that probably wasn't the last time. Brian always suspected that the Aztecs had uncovered something that led them down their high-tech but

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bloody path; now he'd bet he could describe just what they found. A cache of alien memory devices, at least one of them still functional enough to plant a seed in a receptive mind.

That was the sad thing explorers had discovered in their examination of the myriad relics left behind: Aliens died, but their ideas lived on. Often twisted and warped to fit human minds and human agendas, but they spread like fire. It usually took a fanatic to promote them, but these particular aliens seemed to have found a way to make a fanatic of anyone.

The tube Sharrol and Brian were in curved around, and they heard voices in front of them again. Brian looked for a side-passage, found one between two buildings, and they ducked into the next tube over. It veered away toward another one, and from there they crossed to another, and so on until they looped back around to the living quarters.

Pierre was waiting for them. "You're not going any—" he said, just before the headset Brian threw crushed his throat. The memory devices made decent boomerangs as well. Brian wondered if that's where the Australians had learned the trick—from artifacts with dead batteries that were useless for their original purpose. Fortunately, that idea had spread as well.

"Dave," Sharrol said again. "We have to rescue Dave."

"No time," Brian told her. Pierre was good at moving in zero-*g*; he had no doubt outdistanced the others on his way back to head them off, but they couldn't be far behind.

Brian pulled Sharrol through the airlock and into the ship. He couldn't figure out how to seal the station doors, but he knew his ship. He killed the power to its door. It was designed to withstand five hundred *g*s; nobody would be coming through it unless he let them.

"Into the tanks," he told Sharrol. She nodded and went down the passageway toward the crew quarters. Brian headed for the bridge. This time there was no hesitation. He stripped off his clothes, climbed into the tank, and said, "Flood it." The computer started the oxylene flow. When it reached his nose he inhaled it greedily.

Status? he typed on the talker panel.

"Crew are not present," the computer replied.

Not even Sharrol? Had her injury finally caught up with her?

There was another explanation. *Airlock status*? he typed, and sure enough, the computer reported, "Ventral lock open."

She had gone back for Dave.

Brian could have drained his tank and gone after her. Or he could have launched then. He did neither. He gave her as much time as he could, but when he saw motion through the peep hole in his tank he tapped the launch key.

"Crew is not secure," the computer said.

Damn it. *Command override*, he typed.

"Authorization sequence?" it asked.

A loud clang nearly deafened him. They were beating on his tank. If he survived this he vowed never to tap on an aquarium to startle the fish again.

He typed the ten-digit code into the talker panel.

The oxylene just inside the porthole flashed into vapor. They were shooting their masers through the hole.

Launch, he typed.

"Are you sure?" the computer asked. "Crew is not present, passengers are not secure, and we're still docked to—"

He stabbed the button again. *Launch. Launch, launch, launch.*

The bomb went off. The walls of his tank flexed. Lights flickered. The bubbles in his oxylene, crushed by the sudden acceleration, vanished as if by magic.

Abort, he typed. There was no need to add insult to devastation.

Drain tank.

When he stepped out, the floor was coated with red goo. He floated above it to the control panel, flipped the ship end for end, and looked through the

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porthole at the Artifact. It was an expanding cloud of debris, completely unrecognizable now. None of the tubes had survived. He didn't know about the memory modules, but the one he had smashed earlier hadn't seemed strong enough to survive an explosion of that magnitude.

Neither were Sharrol and Dave. Nor anyone else on board, not even the passengers still suspended in cryo. Brian felt a lump in his throat and he waited for it to expand and choke off his air, but it didn't, quite.

He thought about Pierre, so callous about other people's lives since their last trip out there. He must have been indoctrinated then, and been part of the plot to spread the alien religion back to Earth. Had he smuggled any of the alien memory devices home yet? Probably not. Getting them past the tech police would have been nearly impossible without help. He would have used their last layover on Rockaway Station to set up a smuggling operation, which he no doubt intended to set into motion this time.

Well, I certainly put a stop to that, Brian thought as he watched the debris from the Artifact spread out into space. He would have liked to think he had no other option, but he wondered. Sharrol had rushed back into danger to save her lover; he had chosen the easy way out, at the expense of sixteen people's lives and another seven who never got out of cryo. He had done it without malice, but without remorse as well.

Julie had hit him with one of those damned memory devices the moment he got on board the station. She'd had to have a reason for it. Maybe she'd just been softening him up for the full indoctrination later, or maybe that had been it right there, her memory of nude skydiving just a smoke screen to hide what she was doing to his subconscious mind at the same time. Robbing his respect for life and instilling loyalty to a higher power.

If so then she'd been hoist by her own petard. Brian actually chuckled when he thought that. And then he knew. Damn, damn, damn.

He hadn't stopped it. Not yet. There was still one infected person left, and as anyone who'd dealt with religion knew, once the concepts were in your brain they were nearly impossible to get out. They slipped through in your behavior, in your word choices, in your secret fears and desires, affecting you and the people around you for the rest of your life.

But how much damage could one person do? He wasn't a prophet or a messiah.

That's what they all said. Typhoid Mary didn't feel sick, either.

He'd read about previous alien thought patterns, how they'd allowed people to commit such atrocities, how sometimes entire cities had been emptied, houses and monuments left standing, by the blood sacrifice to a rogue system of belief. This one seemed to have the potential to be equally bloody. It had turned trained scientists into ritual killers; it would be nearly unstoppable back home. Even without the headsets, it could spread like fire.

He rested his forehead on the cool glass of the porthole. He couldn't be sure he was dangerous. He might have just been scared when he ordered the ship to launch. But he knew he'd gotten Julie's memory of killing Anton, and he remembered feeling momentarily excited by it. He also knew if he didn't take action now he would never have the strength to do it later, and with religion it was better to be safe than sorry. He couldn't even risk a message, for fear the alien concepts might leak through somehow in subliminal form.

He took a deep breath. "Set . . . set course for Earth," he said.

"Course set."

His mouth felt suddenly dry. He swallowed, said, "Launch."

The computer said, "You are not in your—"

"Command override is still in place," he reminded it. "Launch."

The first of many bombs exploded. ■

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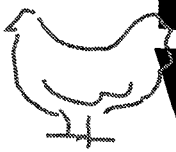
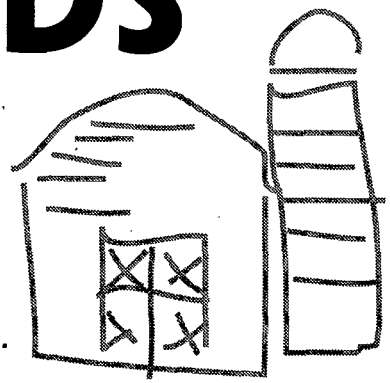
Brian Plante

DRAWN WORDS



Once stung, people become leery of even the most useful technologies. And that doesn't just mean hardware. . . .



Ewen Muir held up the drawing. "It's a chicken," he said.

"A chicken?" said Ewen's mother, Mairi, making a puzzled face. "Well, maybe when it's finished. I don't see anything there but a few squiggly lines."

"But it *is* finished. I've drawn just enough to see the chicken. All the rest is just details."

Ewen's mother stared at the paper and shrugged. Why couldn't she see it, Ewen wondered. At the age of twelve, he was easily the best artist in the county. The drawing he made of his father Gow and older brother Geordie plowing the fields had won a first-place ribbon at the annual summer fair. Even though Ewen's talent wasn't much use in the business of farming, his work was so good that his parents could scarcely begrudge him the luxury of that rarity of bartered goods, paper.

"Gow," Mairi called to her husband in the next room, "does this drawing look like a chicken to you?"

Ewen's father put down the gouge he was carefully honing against a whetstone and came over to look. Gow was a tall man, thin and wiry, with a laugh that belied his slight frame. The seasons of hard toil on the farm had etched his face with wrinkles beyond his forty years and his thick beard was showing traces of gray, but his eyes still sparkled with vigor as he viewed the drawing. "Yes, I do see something that might be a chicken when he's done with it."

"But I *am* finished," Ewen said. "See, this pointy bit is the beak, and this loop is the head, and this other one is the wing and the body. The extra little line underneath is supposed to be a leg."

"Nonsense," Gow said. "A line or two can't be a chicken. You have to add feathers, connect up those open spaces and color it in."

Ewen had been afraid they wouldn't understand. He had drawn chickens before. Good ones. And cows and horses and trees and houses and people. It was easy to draw things the same way other folks who had the talent did it. He was trying to do something new.

"But you see it, don't you?" Ewen said.

Illustration by Shirley Chan

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"If you can see the chicken with just a couple of lines, then it's enough."

Ewen's brother Geordie came away from the basket-weaving he was working on to see what the fuss was about. "That's surely no chicken I've ever seen, Ewie."

"Yes," Mairi agreed. "I think I can make it out now, but why don't you fill in the rest of it so it looks like a normal drawing?"

"But that takes too long," Ewen said. "If I draw just a few lines that can represent the whole chicken, without having to draw every single feather, then I can draw it in just a few seconds."

Worry lines appeared on Gow's forehead.

"Why would you ever want to be able to draw a chicken so quickly?" Mairi asked.

"It's not just chickens," Ewen said, turning over the paper to show a few more sketches underneath. "See, here I have a shape for a cow, a horse, and a pig. This pointy box is the shape for 'house' and this one—"

"It's a man," said Gow.

"Yes, yes," Ewen said, excited.

"Finish them, boy," Gow said sternly. "These are not proper drawings, and I don't care how quickly you can render them. A drawing of a man needs a proper face and hair and fingers. This is just a circle and a couple of lines, like a baby would make. There's no need to skimp on your art. Remember, anything worth doing is worth doing well."

Ewen's smile was replaced by a puzzled look. "But father, these aren't regular drawings. I think of them more as words drawn out on paper, and they stand for things just like spoken words stand for things. Instead of saying 'the cow went into the barn' I can draw a few shapes like this."

Ewen quickly sketched tiny shapes for "cow" and "barn", with a dashed line between them, and held it up to his mother and father to see.

Mairi's breath caught in her throat.

Gow snatched the sheaf of papers away from the boy and examined them. "Listen to me well," he said, turning them over, one by one. "You never drew these." When he reached the end of the collection he walked over to the fireplace and dropped the stack on the flaming logs.

Ewen started to rise when he realized what his father was doing, but Mairi held his wrist firmly and gave him a leave-it-be look that he knew better than to challenge. He looked to his brother for support, but Geordie knew when to stay out of it and had quietly gone back to his basketwork.

When Gow was finished at the fireplace, he turned to face his son with a look that was more frightened than angry.

"Ewen, you have to promise your mother and me that you will never make these drawn words again. Never."

Ewen looked over to his mother, but she nodded in agreement.

"But why? With drawn words I can make a whole story instead of just showing one scene at a time. It's like talking on paper."

"I know what it's like, and I won't allow it in this house."

"But it's just words. What's the harm?"

Gow's face grew very serious. "Drawn words are against the law. It used to be called *writing*, and it has been banned for over a century."

"Writing," Ewen repeated, trying out the unfamiliar word. "Well, couldn't I just make the . . . writing . . . for myself? Nobody else has to see them."

"No. Absolutely not. Do you know what they do to people who write?"

"I didn't even know there was such a thing as writing, so how could I know what the penalty is?"

"Don't talk back to your father," Mairi said, a trickle of tears beginning in both eyes.

"Writing is a serious offense, with grave consequences," Gow said.

Ewen stared at his father. "For draw-

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ing words? But it's a *good* thing, isn't it? Stories could be saved on paper instead of having to remember them. People could trade stories like they trade vegetables and crafts. What's wrong with that?"

"People used to do just that sort of thing all the time before the Holy War," Gow said. "Men used writing to remember things that were best forgotten, and bartered the sweat of their brow for scraps of paper with writing on them. Writing caused our ancestors nothing but grief, and it was a blessing when their wicked society was destroyed."

Ewen was beginning to cry. "B-b-but I just wanted to draw good words about the farm, and you, and mother. Words aren't evil!"

Gow put his hands on Ewen's shoulders and looked him squarely in the eyes, "Ewen, you have to promise me from now on that you will only make proper drawings, or else we just won't be able to barter for any more paper for you. Is that clear?"

"Yes, sir," Ewen said. He couldn't imagine not having any more paper to work on.

"Do I have your word on it?"

"I g-guess so."

"Good. Now why don't you draw us a nice, normal chicken with feathers and such?" Gow said, handing Ewen a fresh sheet of the precious paper.

Ewen began working on a meticulously accurate rendering of a Dorking fowl in the barnyard, being extra careful to capture even the most minute of details. No one could argue that the drawing skimped in any way, it was so lifelike. In the background, a chopping block and ax were plainly visible, but the happy chicken seemed oblivious to the danger.

Ewen tried to keep his promise, but drawing objects the way they appeared in life no longer interested him. For every three conventional drawings he made, mostly to be traded away in town for small items and future obligations, he squirreled away a fourth sketch. He continued his private work whenever he could steal a few minutes away from the eyes of his family, and his collection of drawn word stories grew. He kept them hidden in the bottom of his clothing chest, and showed them to no one.

Over time, his repertoire of drawn words grew. Imagining that the old people before the Holy War must have had a drawn word for just about everything if they could tell proper stories on paper, Ewen set out to invent a shape for as many words as he could think of. Not just the easy words like "horse" and "tree", but intangible things like "fear" and "love". He made sketches for action words like "walk" and "sew", and modifying words like "fast" and "good". Some of the words didn't readily suggest pictures that could be stripped down to their barest essentials, so Ewen just made up arbitrary shapes for those. Other words he made from combinations of simpler symbols.

Ewen's stories were usually transcriptions of the old tales his parents told him. Stories of strong men and women surviving the bad times to build a simpler way of life. Even though he had memorized the stories from hearing them over and over, he was privately happy with the knowledge that he could never forget them now that he had set them down in drawn words.

Over time, Ewen began to think that his own life was a story worth setting down, too. He began making daily progress in an ongoing record of the events that transpired in his life. Sometimes nothing very important happened, and Ewen just wrote down his thoughts and dreams on those days. It surprised him how quickly the story of his life began piling up, and he felt sad for all the other people whose lives just slipped away unremembered.

One day late in his thirteenth year, Ewen was sitting in the outhouse, working on his drawn words in the dim light

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that seeped through the cracks, when his father opened the door without knocking. Gow immediately apologized when he saw the stall was occupied and turned to go, but he caught a glimpse of the paper on the boy's lap. Tiny, graceful shapes in long neat rows filled the sheet.

Gow snatched the paper and crumpled it into a tight ball.

"This is the last of these, Ewen Muir," he said, pointing a shaky finger at the boy. "There will be no more paper in this house, do you understand?"

Ewen quickly pulled up his trousers and ran from the outhouse as fast as he could. His father cursed and dropped the wadded up paper into the honey bucket under the outhouse bench.

It was three days later, early in the morning, when the mayor and town elders burst into the farmhouse, enraged and accusing. Mr. Skene, the weasel-faced man who carted away the night soil and animal waste every week, was three steps behind them entering the house. Ewen's heart pounded like the blacksmith's hammer when one of the elders produced a stained, wrinkled sheet of paper bearing long rows of his drawn words.

"Skene here says he got this out of your outhouse, Muir," said the mayor, an older man with a nose ruddy from too many nights of drinking spirits.

"I thought it might be one of the boy's drawings," Skene said, "but when I flattened it out, I didn't know what it was."

"It's writing!" the elders shouted.

Ewen saw the color drain from his father's face as he tried to calm them down. "Gentlemen, it's just scribblings, nothing more. Let's all sit by the fire and share a cup of mead, shall we?"

"Muir, this is no mere scribbling," said the mayor. "We don't know what it means but the shapes are too consistent."

"Some of the symbols repeat," another man said. "It can't be meaningless scribble if it's so regular-like!"

"The Holy War never ends, Muir," said the dour-faced mayor, beckoning to the door. "You have to come with us, before you bring the fire down on all our heads."

Mairi gasped and reached for her husband, but two of the elders held her back. Geordie took a few steps toward the group with his fists raised, but his father waved him off.

"Wait," said Ewen. "You're right, it is writing. But it's mine, not my father's."

The old men turned to face Ewen.

"He's lying," said Gow, looking frightened for the first time. "All right, I'll admit it. I have been writing like people did in the old days before the Holy War. Have mercy on me, for my family's sake."

When the men all turned their attention back to Gow, Ewen grabbed the filthy sheet of paper away from the mayor and held it out in front of him.

"No, it's mine," Ewen said, "and I'll prove it. The paper says, 'My father works so hard to make life good for Mother and Geordie and me. How many fine memories does he have that will be forgotten when he is gone? I will remember as many as I can for him.'"

Gow started to laugh. It was not his usual hearty laugh, Ewen noted, but a sham laugh for the elders. "Gentlemen," he said, "my Ewen is a good son, is he not?"

"God almighty, Muir, he read the writing!" the mayor said.

"He did nothing of the sort," Gow said. "He just made it up to protect me. You have your man, so let's get on with it."

The elders looked back and forth nervously at one another. Finally, one of them took the paper from Ewen and waved it in front of Gow, saying, "Read it then, if you know how."

Ewen saw his father stiffen as he looked at the paper. Gow cleared his throat nervously, and a few of the elders began eyeing Ewen with suspicion.

"The paper reads as follows," Gow said. "I, Gow Muir, a farmer of the land,

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believe the written word is a righteous thing."

The elders gasped and murmured. The one nearest Gow took a firm hold of his shirt.

"Before the Holy War, life was surely better than it is today. The townspeople are all fools, and I alone among them have the gift of writing."

"That's enough," said the mayor. "Gow Muir, you're coming with us."

"No, no!" Mairi screamed.

The men led Gow to the door. Before they pushed him across the threshold he turned back, and Ewen caught one last look of love in his eyes. Mairi, Geordie, and Ewen tried to follow, but several of the elders pushed them back inside.

"There's a duty to be done," one of the elders said, "and it's not a proper sight for women and children."

The town fathers were decent enough to cut Gow's body down from the big oak tree behind the house before they left, sparing Mairi and the boys the sight of him hanging. Ewen and Geordie dug the grave and they buried him right there under the tree.

The next morning, Ewen ran away from home. Geordie was a better farmer than he would ever be, and with his mother, the two of them would be able to manage the farm just fine without him. Before he left, in the predawn hours, he worked tearfully above his father's grave. Around the base of the big oak he carved a series of curves and lines skillfully into the bark. The shapes were subtle, looking almost as if worn into the tree by nature. Only Ewen knew what they spelled: "Father, forgive me."

Ewen followed the Tweed river west from Selkirk to Peebles, then north to the Firth of Forth and Edinburgh, a journey of four days. He carried a sack of foodstuffs from home, but the long hike increased his appetite, and he soon had to resort to stealing fruits and vegetables from farms along the way.

Edinburgh was the biggest city around, and Ewen only knew it by reputation. There were more people in one place than he had ever seen before—hundreds, perhaps thousands. Not just farmers, but tradesmen of all kind, and the crowded streets were lined with all manner of shops. There were tailors, butchers, woodwrights, blacksmiths, luthiers, and other shops for city things that Ewen didn't recognize.

By the time he reached the city it was late morning and he was ravenous from the long walk. The smell of cooked food coming from inside a public house drew him in. Ewen stood by the door for a minute before entering the busy room. A matronly serving-woman bid him to be seated, but he was leery of unfamiliar city customs.

"Excuse me, ma'am," Ewen said, holding up one of his drawings, "but how much food could I get in barter for something like this?"

The server glanced at the drawing, then back at Ewen, laughing. "That's a right good 'un, but I'm afraid you won't get a cracker for it in here. You're from the southern uplands aren't you?"

Ewen nodded yes. "Then what manner of barter do you accept?"

"What do you think, you silly bumpkin? We take coins—silver and gold. A quid for a meal, and a quarter for a draught, although I daresay you're a wee bit young for an ale."

Coins. They didn't use such things in the farmlands, always trading directly for goods and services. After all, you couldn't eat a coin, Ewen thought. But for a city like Edinburgh, where most people were not farmers, perhaps it made some sense.

Ewen held out more of his drawings. "I only have these. Is there a marketplace where I could trade something like this for a few of your coins?"

"The whole city's a marketplace, dearie. Your drawings are pretty, but I don't know who might want to buy them. Maybe if you drew religious

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scenes instead of farm animals you might sell some of them to the crazy monks."

Ewen left the public house and wandered the streets, looking for some kind of shop that might trade in artworks. Several hours later, when he found none, he decided to open his own impromptu business. He took a half dozen of his best renderings from his bag and propped them up on the walkway, against the front of a cobbler's shop. Before he could finish setting up his display, the cobbler burst from the shop and yelled at him to get that trash off his property.

"I'm sorry," said Ewen. "I didn't know the walkway was private."

The cobbler frowned at him and looked at the artwork, stroking his long salt-and-pepper beard with a heavily callused hand.

"Those are pretty fair drawings," said the cobbler. "Did you make them yourself?"

"Yes sir, I did. And lots more. Would you like to see them? They are all for sale, if you would like one."

"No. I have no use for drawings, but I can see you have some skill with your hands. Looking to make some money in the big city, are you?"

"Yes sir, I am. I'm new in town and don't have any coins yet."

The cobbler made a sour face. "I can see you aren't from the city just from your clothing. They don't look like they were made by a proper tailor."

Ewen looked down at his garments. "My mother made them."

The cobbler rolled his eyes. "Boy, if you are in need of money, I might find use in my shop for an assistant, if you can handle the work. I cannot pay very much, but if you are any good, you might learn a useful trade."

Ewen pointed to the sign on the front of the cobbler's shop, a poor rendering of a shoe, much larger than life, but crudely drawn, probably by the cobbler himself.

"Would you like me to make you a proper sign?" Ewen asked.

"There's nothing wrong with my sign," the shopkeeper said, glaring at him. "I want you to help me make shoes."

Ewen's first thought was to pack away his drawings and move on, but the gnawing hunger in his stomach was overpowering.

"I don't know how to make shoes," Ewen said.

"I'll teach you what you need to know," said the cobbler. "If you have any talent with your hands, you can learn."

The cobbler's name was Logan, and over the next few months he trained Ewen to fashion simple footwear. Ewen's shoes were not fancy like the cobbler's own handiwork, but they were wearable and served well for the working people who couldn't afford the master's better wares. Ewen was allowed to sleep nights on the shop floor, in exchange for a portion of his meager wages. The cobbler also kept him barely fed for another portion of his dwindling earnings and only a pittance was left over for paper and art supplies, but it was enough for his few needs.

Logan had a collection of wooden foot models of different sizes, and Ewen was expected to make shoes to fit each of them, all exactly the same except for the size. He learned quickly to turn out a simple clog design, but before long the monotony of the task began to bore him. He wanted to try his hand at the more sophisticated models the cobbler crafted, and watched him carefully.

"Master Logan," he said to the cobbler, "what is the purpose of the little crown symbol you stamp onto the soles of the shoes you make?"

"That is my trademark," the cobbler replied. "It identifies the shoe as having been crafted by a master cobbler—me."

"So a simple mark signifies your work. Isn't that like what they used to call 'writing'?"

"Writing? You mean like books?" the

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shopkeeper said, looking surprised. "No, no. It is just a mark to tell my shoes apart from those made by other cobblers."

Ewen wondered what the odd word 'books' meant, but asked, "Can I put a trademark on the shoes I make, too?"

The cobbler looked puzzled. "But then my customers would get confused over which shoes were really made by me."

"Oh, I don't want to copy *your* trademark," Ewen said. "I'll make up my own mark, to insure sure no one confuses your superior craftsmanship with my novice work."

"Of that there's nary a need, I think. But if it would please you, go right ahead. Just be sure to make your mark different enough from my own so there can be no mistake."

"You can be sure of that, I promise."

Ewen drew and redrew sketches of his intended mark on paper first, getting it just right before he began embossing the design on the soles of the finished shoes. Instead of the small crown logo that Logan stamped into the leather of the shank, up near the heel, Ewen decided to make something larger, using the whole flat outsole of the heavy clogs that he toiled over for his mark.

His trademark was a portrait of his father.

It was a hard-working face, all bristly and rugged, yet still kind. The softness about the eyes was not lost on the rough underside of the heavy work shoes. Each of the portraits took nearly as long to tool into the hard sole as it took to produce the entire shoe, and Ewen worked at applying his trademark to the shoes in the evening by candlelight, after the cobbler had gone upstairs for the night, so the old man would not know how much time he was wasting.

Worked into the portrait, skillfully hidden in the twisting whiskers of his father's beard, were the drawn words, "Father, forgive me."

Over the ensuing months, sales of the clogs were brisk, and Ewen soon learned to duplicate his trademark quickly. It seemed he could never make the shoes fast enough to build up the shop's inventory to the levels Logan demanded. While he toiled in the back of the shop, Logan sold the shoes in the front, so Ewen didn't know who was buying his creations, but someone surely was. A lot of someones. Ewen kept tally on a scrap of his drawing paper, one tick for each pair of clogs he made, and each group of ten circled. There were a lot of circles.

One day while Ewen was in the front of the shop taking orders from Logan, one of the more affluent customers came in and asked to be fitted with a pair of clogs. Logan tried to convince the customer that his brogues and balmorals were much better suited to the customer's station, but the customer insisted on a pair of "those shoes with the faces on the soles." Logan finally relented and sold him the clogs, charging the customer half again what he normally charged the common people for them, but the customer left the shop happy nonetheless.

That evening, after the workday was done, Logan fished a few coins out of the till and handed them to Ewen, saying, "I'm afraid I don't have any more use for you here. You'll have to go."

"But why?" Ewen asked.

"Look at this place, boy. The shoes are piling up in our inventory."

Ewen looked and saw the oxfords and balmorals and pumps, all the master's shoes, that had gone unsold over the past weeks.

"But people are still buying plenty of my clogs," Ewen said. "I've made nearly two hundred pairs and hardly any of them are left."

"Clogs are cheap," Logan said. "I need to sell proper shoes to a better class of people to make a good living. I need to sell the shoes that *I* make. I'm sorry, but an eager worker like you is sure to find something else to do in a city this size."

That night, with only a few saved

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coins in his pocket, Ewen packed his drawings in his sack and left the cobbler's shop.

Several weeks went by after he had been discharged from the cobbler's shop, and Ewen still could not find another job. Work was scarce this time of the year with the harvest recently over and many unemployed farm hands looking to find a niche in the city before the winter cold set in. Begging was the only job Ewen could manage, making lifelike chalk drawings of cows and chickens on the wooden walkway near the center of town to attract the passersby.

Even at begging Ewen was a failure, barely making enough small change for the occasional drink of ale to go along with the crusts he fished from the waste bins behind the public houses. He thought about leaving the city, but with winter coming and the harvest already in, there were no field jobs to be had nor crops to be filched. It seemed his only option would be to return to his mother and brother, but he could hardly face them after the tragedy he had caused back home.

Thinking more and more of his dead father, Ewen began sketching his portrait on the sidewalk as a tribute, and business instantly picked up. He seemed to have hit on something, as pedestrians would stop and admire his work with much more frequency than when he drew farm animals.

Each morning, Ewen touched up the larger-than-life portrait of his father he had drawn with colored chalk on the wooden walkway near the center of town. For some reason, the local rascals would deface it nightly after he had left to find a warm spot for the night, adding a crude halo over his father's head. If it didn't rain during the night, it only took a few minutes with a damp rag to erase the halo and add more chalk to the places where the color had worn thin from pedestrians' footsteps.

Hidden cunningly in the chalk portrait, just as on the shoes, were the drawn words, "Father, forgive me." On one side of the portrait, Ewen drew a couple of large coins, as a suggestion to the people who stopped to look. Ewen sat on the other side of the portrait and spent the hours sketching on what little paper he had remaining.

Many of the pedestrians seemed to recognize the face on the sidewalk and stopped to admire it. Ewen noted many of those interested spectators wore the shoes he had created. Once in a while, one of them would drop a real coin onto his chalked ones.

One day, as Ewen struggled to keep his drawing paper from fluttering away in the chill autumn breeze, he was distracted when a thin man dressed in black robes roomy enough to hold two of him looked over his shoulder with curious eyes. "That's a queer sort of drawing," the man said, looking at the paper. "Those shapes look almost like they might be some sort of writing."

"It's just some designs I'm working on," Ewen said, hurriedly stuffing the bundle of sheets into his sack.

The man looked down at the portrait on the sidewalk and said, "I rather like that. It's the same face as the one on the shoes, isn't it?"

Ewen nodded yes and smiled, hoping the man liked the portrait enough to drop a coin for him. Under the black robes, Ewen saw he was wearing a pair of his clogs.

"So, you're the one who made all the faces, then?"

Ewen nodded again. He was certain the fellow would leave a coin or two now.

"Could you answer a question for me and settle a dispute?" the man said, pointing at the sidewalk. "What's the meaning of those odd figures there, around the beard?"

Ewen's face flushed red. First the shapes on the paper, and now the hidden ones in the portrait. The man surely knew his drawn words were more than

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just random designs. The memory of the elders taking away his father played out briefly in Ewen's mind. Maybe it was time to own up to his work.

"I . . . I . . . it means 'Father, forgive me,'" Ewen said.

The man's eyebrows arched and he looked over the portrait again. "Father, forgive me? Is that supposed to be some kind of a prayer?"

Ewen thought quickly. "A prayer. Yes, a prayer. This is a picture of Jesus, and those are, um, His dying words on the cross."

The man frowned. "Jesus said, 'Father, forgive *them*, they know not what they do.'"

Ewen stiffened. "Well, maybe I heard it wrong."

"I thought it might be Jesus," the man said, "but shouldn't He be drawn with a halo? I'm afraid that He looks just like a common farmer the way you've drawn him here."

"Jesus *was* a common man," Ewen said.

The man reflected on that a few seconds. "Well, I just think He looks better with the halo."

Ewen thought about the halo the children added nightly to the portrait and asked, "Do you know about the halo?"

"Why, of course! You made the shoes, right?" the man said, pointing to his feet.

"Yes, but what about—"

"And the odd shapes in the beard mean, 'Father, forgive me,' but it's not in any kind of writing I've ever seen."

Ewen nodded, then thought about what the man implied. "You say you've seen writing? I mean, not my little squiggles, but real writing?"

"No," the man said, looking away nervously. "That's not what I meant."

"But you said—"

"You misheard," the man said, fishing a coin out of his pocket and dropping it on the sidewalk. "You be careful now."

The coin rolled along the walk and Ewen scrabbled after it, snatching it while it was still in motion and squirreling it away safely in a deep pocket. When Ewen looked up, the man in black was gone.

The next morning at his usual begging spot, Ewen found that someone had once again added a crude halo to his sidewalk portrait during the night. Instead of wiping it away this time, Ewen decided to let it remain, adding color and smoothing out the curve of it instead. There was no use fighting it, especially if the notion that his father's portrait was Jesus Christ was gaining some popularity. Maybe it would bring him a few extra coins to play up the phony religious angle. Perhaps that was the reason all along why the face had proved so popular.

The plan seemed to be working, and by late in the afternoon Ewen had collected more than enough coins for a decent meal when a familiar figure showed up to admire his handiwork.

"It's a sure moneymaker, that drawing of yours," the man said. It was Logan, the cobbler.

Ewen looked up at him from his seat on the walkway. "It's brought me a bit of luck," he said.

"Look, boy," said the cobbler, "I was a little hasty in sending you off like that. Since then everyone in town has come into my shop asking for a pair of those shoes of yours with the damned face."

Ewen smiled and touched up a spot on the sidewalk with some chalk.

"See, I'm asking you to come back," said the cobbler. "I'll give you half again what I was paying you before, if you'll just come back to my shop."

"Oh, I don't know," said Ewen. "I don't think I want to make any more of those clunky clogs."

"Then I'll show you how to make the fancy, expensive models," Logan said. "You don't even have to make shoes at all, if you don't want to. I'll make them. You just come back to the shop and put the faces on the soles."

"What, put *my* trademark on your su-

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perior work?" Ewen said in mock horror. "Won't the customers be confused?"

"Lad, I *need* those faces on the shoes."

Ewen looked away. "It's just a face. Why is that so important to you now?"

Logan lifted his foot, and for a second Ewen thought he was going to kick him. But Ewen recognized the shoe as one of his own clogs, and the cobbler held his foot up for him to look at. There on the sole was the face, his trademark, just as Ewen had tooled it into the hard leather. A bit worn from wear, perhaps, but still recognizable as his father's visage.

Where the leather sole had worn under the ball of the cobbler's foot, a round halo had appeared, framing his father's face.

"People say it's a miracle," the cobbler said. "A sign from God."

Ewen laughed. No wonder the portrait, with the added halo, was becoming so popular.

"Look, boy, come back to the shop and I'll double what I was paying you before. If you don't come back and put faces on my shoes, I'm going to be put out on the streets."

Ewen stared at Logan a few seconds, then said, "It's not so bad on the streets. You'll get used to it." He dug deeply in the pocket where he hid his coins, and came up with a hard-earned quarter, holding it out to the cobbler. "Here, Master Logan, go buy yourself a draught on me."

Another week passed and the days grew chillier. One early morning found Ewen cutting through a back alley on his way to his usual sidewalk begging post. A patch of color on one grimy wall of the building near the mouth of the alley caught his attention. It was his father's face, painted right on the bricks.

The painting was an obvious imitation of the sidewalk portrait he had labored over for the past few weeks, and not at all a bad effort. The halo was featured even more prominently than he had been drawing it, so the lie that the face was Jesus must have been spreading. Ewen also noted that the drawn words that he normally disguised in the beard were all wrong in this portrait. Instead of his graceful curves, there were harsh angles and loops that bore little resemblance to his original drawing.

As Ewen reached the main street, he spotted a group of three boys a few years younger than himself loitering near the mouth of the alleyway. Their clothing was ragged and their faces showed a trace of grime, so Ewen surmised they were runaways like himself.

"Excuse me, lads, do you know anything about this painting on the wall here?" Ewen asked.

The boys peeked around the corner of the building to see the painting. "Oh, that drawing is all over town," said the redheaded boy.

"Folks are calling it the Savior of Soles," said the boy with large patches on both knees of his well-worn pants. "You know, like on the shoes."

Ewen chuckled. Savior of Soles indeed. The three boys didn't laugh along with Ewen and looked very serious, so he stifled his laughter. One of them was the painter, he guessed.

"It's a good painting," Ewen said. "Just like the chalk one I've been keeping on the sidewalk near the square. Those funny shapes in the beard are a bit different, though. Do any of you lads know what those shapes are supposed to be?"

The redhead and the boy with the patches looked back and forth at each other and shrugged. "I dunno," said the third boy. "That's just how the drawing goes, isn't it?"

Ewen noticed a spot of paint on the boy's sleeve and guessed he was the artist.

"Well, not really," Ewen said, digging into his sack to pull out the sketches he had made when he was first designing the trademark for his footwear. "This is *my* drawing, so I guess I should know how it goes. Here, take a look at these."

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"Hey, that's not right at all," said the boy with the paint-spotted clothing. "It doesn't even have a halo."

"*This* is the original drawing," Ewen said. "The halo came later. Look closely at the shapes in the beard. That's what's wrong in your, er, the painting over there on the wall."

The boy studied Ewen's drawing carefully, but the redheaded boy pulled a folded sheet of paper from a pocket and gave it to Ewen.

"This is what the face is supposed to look like, isn't it?" asked the redhead.

Ewen examined the paper. It was his father's face with the halo, faithfully copied in dark black ink, but the drawn words in the beard were all wrong. Whoever created the copy hadn't realized the significance of his graceful shapes, and had substituted harsh, angular ones in their place.

"Where did you get this paper?" Ewen asked, refolding the paper and pocketing it.

"The rectory gives them out with free food," the redhead said. "Sometimes we go there when we're hungry. We're supposed to pray to the face on the paper, I think."

"Well, they've got it wrong," Ewen said. "The original shapes I drew *mean* something. Let me show you how to make them correctly."

Over the course of the next few hours, Ewen showed the three of them how to draw "Father, forgive me" in drawn words. He explained how he had created the shapes, going from fully fleshed drawings to stripped-down ones, and illustrated the transformation with a series of sketches on a sheet of paper. The boys were attentive and had little trouble understanding the concept and practicality of drawn words. Ewen cautioned them that it was "forbidden knowledge," which only made them even more interested in learning it. The boy with the paint-spotted clothing picked it up quickly and then began helping the others. Ewen and the boys became fast friends and traded other useful information, like good locations for begging and places where decent meals could be salvaged from the refuse cans.

"If you can draw a few little shapes to mean just about everything," said the redhead, "then are there drawn words for our names, too?"

Ewen learned their given names were Derek, Lachlan and Fergus, but rather than make up new shapes for them, he sketched the words for "red," "patch," and "painter" on individual scraps of paper and gave them to the boys. The three of them prized their written names, and began tracing the symbols in the air with their fingers, memorizing the shapes.

"Be careful about who you show these drawn words to," Ewen implored. "You could get into big trouble."

"Don't worry about us," Patch said. "We can look out for ourselves."

Ewen said good-bye and went to his usual sidewalk spot happy over having made his first real friends since leaving home. Over the next few weeks he would see the drawn words for "Red," "Patch," "Painter," and "Father, forgive me," appear in charcoal, chalk and paint on numerous walls and buildings all over town. His protégés were seemingly everywhere, reveling in the conspicuous display of their marks and testing the limits of their rebelliousness. Ewen met with them often over the weeks, and at each meeting the boys would ask him what the drawn words were for various things and carefully copy the symbols that Ewen showed them.

Ewen, too, began scrawling words on the walls after the sun went down. Things like, "Anything worth doing is worth doing well," and "Words aren't evil, men are." Ewen always signed his messages with the drawn word for his name.

Once, Ewen came across the chalked message on a wall, "The Savior of Soles' son is Ewen."

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* * *

The monastery at the edge of town was large and imposing. Ewen bruised his knuckles knocking at the big oak door and waited an eternity before a tall man in black robes came to admit him to a small antechamber.

"I'd, uh, like to speak to someone in charge," Ewen said.

"I am Brother Alastair," the man said, "the abbot of this monastery. You can speak to me."

Ewen pulled out the inked portrait of the Savior of Soles that he had taken from Red. "I asked at the church rectory where these were being given away, and the priest told me they were made by someone here at the monastery."

Brother Alastair gave a quick glance at the paper. "Perhaps. What is it you would like to know?"

"Someone wearing robes like yours once spoke to me on the street where I was begging and admired the portrait I drew on the sidewalk. This portrait. It's my trademark."

"Your trademark? A trademark for begging?"

"Begging and shoemaking. That means the portrait belongs to me and others shouldn't be allowed to copy it."

Brother Alastair looked surprised at that. "But it's a picture of Our Lord Jesus Christ. Jesus belongs to everyone."

"Well, this one belongs to me. I created it, and I know what you people are up to here." Ewen pointed to the paper. "Those shapes on the bottom of the portrait are . . . writing."

The abbot looked aghast. "What do you mean, writing? What, those little lines?"

"Yes, those lines. And I know it says 'Father, forgive me,' in whatever system you use here, if that robed man on the street remembered it correctly."

The abbot stifled a laugh.

"What's so funny?" Ewen said.

"It really says 'Come to the abbey.' It's a message for you."

Ewen's face wrinkled. "For me?"

"We've been waiting."

Ewen stopped breathing for a moment, wondering if a trap was about to be sprung. Brother Alastair just kept smiling, so Ewen said, "Well, here I am. But for what?"

"We are Benedictines here," the abbot said. "Most of us, anyway."

"What exactly does that mean?"

The monk walked over to a small desk and withdrew an object from a drawer. It was a rectangular thing the size of a paving stone, but bound in leather with gilt edges.

"Do you know what this is, son?" the monk asked.

Ewen shook his head no.

"Come over here then and have a look."

As Ewen approached, the monk opened the object to reveal paper inside. Hundreds of creamy, fine-textured pages, stacked tightly against one another and bound on one side. Each page was filled with row upon row of tiny, unfamiliar shapes. The monk turned the pages to a spot marked with a red ribbon and scanned down with his finger to find a passage, then read, "From the book of Isaiah: 'And now, go, write it before them on a tablet, and inscribe it in a book, that it may be for the time to come as a witness forever.'"

"A . . . book?" said Ewen, looking confused. "Whose words are those?"

"Yes, this is called a book," the monk said. "The Good Book, in fact. Its real name is the Bible. Many of us here believe it contains the words of God."

"Old-style writing!" Ewen said. "You could get killed for having that."

"As could you for writing prayers, or whatever, on the sidewalks. While writing is not strictly allowed in Edinburgh, some of our devout souls will admit the value in preserving the word of the Lord. We Benedictines are concerned not just with keeping alive the word of God, but with preserving *knowledge*."

Ewen thought of his drawn word stories. "Can I learn to write in your system?"

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"Yes, of course," the monk said. "We were hoping that you might find your way here and work with us as a scribe. Perhaps as an illustrator, as well."

"You'd just take me like that?"

"Oh, we've seen your work around town before. This writing of yours looks most peculiar, but I can see in it a flair for calligraphy." Ewen made a face, so the abbot added, "That means you write beautifully."

"You can tell that just from the sidewalk drawings?"

"Yes. That and . . ." The monk shifted his weight onto one leg and lifted the other to show Ewen his shoe under the robe. It was one of Ewen's clogs, and there on the sole was his trademark portrait, with a worn-in halo.

"Would you like to stay on here at the monastery and become one of us?" the monk asked.

Ewen thought briefly about lying, but decided to trust the monk with the truth. "I have to admit, I'm not very religious."

"Well, that's not an absolute necessity," the monk said. "More than anything, we need scribes with steady hands."

The monk led him to an inner door and down a hallway to a large room at the back of the building. This room was lighted well from several large south-facing windows. Inside labored a handful of men sitting at desks, slowly copying tiny characters onto crisp white sheets of paper. One of the copyists was familiar as the man who had questioned him on the sidewalk.

"Are they all working on the Bible?" Ewen asked.

"No. We also keep other important works alive." Brother Alastair picked up a finished book from a nearby case. "This one is called *Macbeth*. It is very old. This one is *Tom Sawyer*. It, too, is pretty old."

"Were they saints?"

"Hardly. *Tom Sawyer* is about the adventures of a boy who grew up in America, long before the Holy War destroyed it. It's not a true story, but many people have admired the tale nonetheless."

Ewen looked about the room and noticed many large cabinets holding shelf upon shelf of thick volumes, as if they had been crafted solely for that purpose. Book cases. Ewen found the idea intriguing.

"What do you do with all of these books?" Ewen asked.

"We read them, of course, and trade them with the other monasteries and enlightened parties. They are primarily for safekeeping until the rest of the humanity decides to begin reading once again."

"But aren't you afraid of getting caught?"

"Weren't you?"

Ewen smiled slyly at the monk, who returned the grin.

"Tell me," Ewen said, "if I used writing to record the story of my father—how he lived and how he died—do you think anyone else would want to read it?"

"Perhaps," said the abbot. "It all depends on how interesting a man he was, and how skillfully you write the story."

Ewen didn't have to think about that too long. "Then I'd like very much to become one of your scribes."

Brother Alastair smiled warmly. Ewen thought of the newly found friends he'd be leaving behind on the streets and asked, "If I learned your system of writing, would it be all right to share the knowledge with some friends who might also care to learn?"

"By all means, lad, as long as you're sure these friends can be trusted. We want to encourage people to take up writing again."

"Good. When can I begin?"

The monk put a friendly hand on his shoulder. "It will take some time to teach you to write properly, but we can begin immediately."

"I'm looking forward to it," Ewen said. "Now, tell me more about this Tom Sawyer."

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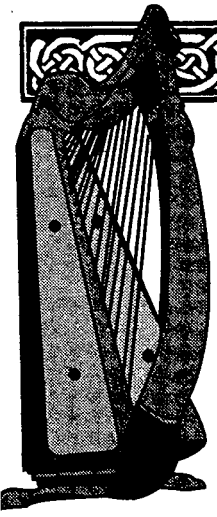
Rick Cook



O'Carolan's Revenge

Fair trade is not always as simple as it sounds. . . .

Three things that make the wise walk wide:
The host of Connaught arrayed for battle,
The lying tongue of a false woman,
The wrath of a bard.

—Triads of Roscommon, circa 8th Century

Turlough O'Carolan, finest harper in all of Ireland, sank down beneath the beech tree and turned his blind eyes toward the warmth of the lowering sun.

It was not the evening he had expected. But Captain O'Neill had died early that summer and his heir had no use for the old ways. The new English steward did not even come to the gate, but sent a footman to tell O'Carolan there was no place for him at the new master's fire when he and his lead boy arrived.

So O'Carolan had called down a bard's curses upon the house and they had journeyed on, seeking a place where they could make themselves comfortable for the night.

The prospects were not cheering. The common folk would have little enough to share, perhaps not even space by a fire and certainly no food. Unlike the old days, there were no other great houses in the neighborhood where they could stay.

For a while he had amused himself by composing scurrilous verses about the new master of Captain O'Neill's holdings. But that had palled hours ago and now he was content simply to rest beside the road for a bit.

O'Carolan sighed deep and settled back against the mist-slick trunk. He was melancholy again and it was not just the weariness of the road, or the damp cold of early autumn, or even the death of a jovial friend and generous host. He was an old man on an old horse keeping to ways that were dying.

Even his guide reflected the change. Before, he would have been led by an apprentice learning the trade. But Dermott was no harper, only the youngest son of a friend who had agreed to guide him for such food and shelter as the bard could provide.

The old Irish everywhere were impoverished by the harsh new laws of King William and King George. Some of the English settlers kept to the ancient customs but fewer every year. It did not take the second sight to know that

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before long there would be none of the great houses and no place for the harpers.

And then what? There would be none left to recall the music that he and generations before him had learned and made. His wife was two years in her grave and he knew he would follow her before long. And not long after, the music he had given his life to would be dead as well.

"I spent a space in Ireland, happy and content,
"Drinking with every effective hero who was a lover of music;
"When they had gone I was left solitary and sorrowful. . . ."

"Two come on foot," Dermott broke in. "A man and a woman."

O'Carolan shifted uneasily. The times were unsettled and a meeting upon the road was not always a thing to be sought.

"Ordinary folk?"

Dermott hesitated. "I do not think so. They are . . . different."

"Then help me up, boy. We shall greet them standing."

O'Carolan gave them greeting when they were close enough and received a proper greeting in reply from the man.

"We are looking for Turlough O'Carolan." The man's Gaelic was odd, with the flat, lisping accent and strained constructions of an Englishman.

The old man inclined his head, as was polite. "That is myself."

"We want to hire you for a couple of days," the man said, still not naming himself. "To play for us."

A horse trader, O'Carolan thought. He stank of the hard, tricky men one heard chaffering at the fairs, driving the hardest of bargains and always ready to cheat the unwary.

"It is said you are the greatest harper in all of Ireland," his companion added. "If you would consent to be our guest you would not find it to your disadvantage." There was an instant's pause. "I am Maeve Fitzpatrick and this is Johnny Adams."

The woman's speech was little better but her voice was soft and her manner gentle. *Truly, an odd pair*, he thought, and wondered what had brought them together.

"Well met, Maeve Fitzpatrick." O'Carolan's pause was longer than hers. "Johnny Adams."

"You shall have a purse of gold," Johnny said. "A fine tight cloak of deepest blue to keep the weather out. And all the fine food and drink you desire while you guest with us for three days and nights." He spoke as if reciting a formula and O'Carolan bridled at the open discussion of money.

"Then I shall accept your hospitality," O'Carolan replied. "And praise and joy be upon your house." Already he had pegged this Johnny Adams as a niggardly host, but at least they would be dry and fed after a fashion.

"Then come with us," the woman said. "Our place is not far from here."

The 'place' stood not two miles from where they had met. O'Carolan, whose two-score years of wandering had taught him the lay of this part of Ireland, did not need Dermott's prompting to tell him where they were when they turned off road shortly after fording a stream.

He knew the place well enough. Once the tower house had been the seat of the Keenans of Leitrim, allied to the O'Niells themselves. But that was before the armies of the English King had come south after the disastrous fight on the Boyne. Before the flight of the cream of the old Irish nobility to the service of foreign kings. The house had been rendered indefensible in that awful summer so many years ago. None of the few remaining Irish lords would inhabit such a place and none of the land's new masters had wanted it. *Until now*, O'Carolan thought. He wondered again what sort of folk he had chosen to guest among.

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"It looks ruined," Dermott whispered to him as they made their way up the path. "There is ivy growing up the keep and gaps in the walls."

"We prefer not to make a show," Maeve said, catching Dermott's whisper. "Inside is snug enough, I assure you."

The bridge over the moat was new and solid, although it rang hollow under the horse's hooves.

"The gate is new," Dermott whispered to his above the clatter of their crossing. "It swings open for us."

Neither hall nor tower had been repaired, Dermott said, but instead a cluster of white cabins with odd flat roofs had been erected in the old courtyard. O'Carolan was helped from his horse and Dermott unloaded the pack and harp in its boiled leather case.

Maeve placed her hand in his. "Come, I will show you to your quarters."

"You are a harper," the blind minstrel said. "I feel the calluses on your fingers."

Maeve hesitated. "I play, it is true. But I would not call myself a harper in such company as yours."

O'Carolan smiled. "Maeve. Queen in name, queenly in modesty, queenly in form and figure."

"Turlough O'Carolan it is truly said that you have a flattering, lying tongue."

"Lady, when God deprived me of my eyesight I lost only the ability to see the outer form, not the person within."

The woman made no reply, but led him onward.

"These shall be your rooms." For a moment O'Carolan was nonplused because they were still standing in the open. But she led them up three steps and opened a door, obviously into one of the cabins Dermott had spoken of. "I will show you how things work."

The air inside was balmy and Maeve led them back to a bedroom and then forward to show them a room set aside for washing. Dermott gasped as she demonstrated how to make hot and cold water flow from a spout in the wall. O'Carolan was much amused as she explained the great fixed chamberpot that stood in the same room.

Once Maeve had bid them rest before dinner and taken her leave, Dermott did not want to leave his master's side. O'Carolan doubted it was because his loyalty had suddenly grown so strong.

"Master, are we among the Fair Folk?"

O'Carolan gave a show of thinking, as if the question were worth pondering. "I doubt it. This place does not match any of the stories of a shee dun."

"Then what are they to live so?"

"They are our hosts, boy. And we their guests."

Dermott nodded as if that explained things and turned to unpacking their belongings.

"Master," he said suddenly. "It is said that a night inside a shee dun is a hundred years to those outside."

"It is also said that the Fair Folk deal honestly with those who deal honestly with them," O'Carolan said sharply. "Now leave be and see to your work."

It was twilight when Maeve Fitzpatrick returned to escort them to dinner. Together they crossed the ruined courtyard to another, larger cabin.

The hall seemed large, but oddly dead. Sound did not echo here and O'Carolan's footsteps were lost.

"Describe this place," O'Carolan whispered urgently.

"A low hall," Dermott whispered back, "spacious enough but longer than it is wide. There is no fireplace and the walls are hung in black. The sun shines bright through holes in the roof, brighter than outside. A small table with a chair with others ranged about it."

O'Carolan nodded and let himself be led forward to the central seat.

"I bid you welcome, Turlough O'Carolan," Maeve pronounced the host's blessing as she showed him to his seat along the table. "You honor us with your presence." Johnny made a noise that might have been agreement. He was clearly her superior, yet he did not offer the blessing himself.

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If his hosts' ways were strange, they had not lied about the food and drink. It was in plenty, from fine joints of beef with the fat crackled upon the outside, to soft bread with the texture of air, and fruits that were large and perfect to the feel, though oddly tasteless. For drink they had Spanish and French wines of the best, strong bitter beer and several kinds of whiskey which Johnny called 'single malt.' O'Carolan's face flushed and his tongue loosened before he cut back his consumption. He must play this night and such hospitality called for his best efforts.

The company was sparse. Just Johnny, Maeve, and a man called Al who occasionally came into the room to whisper in Johnny's ear in English. If there were other servitors within or without O'Carolan could not hear them.

Johnny was a man of little conversation and small wit, but Maeve was a delightful companion. O'Carolan soon found himself regaling her with stories of his travels and exploits.

". . . and so I said to McCabe:

"Remember, fellow, though I drank a lot,

"It was not I who was put in a sack."

Maeve laughed delightedly, Johnny dutifully.

"I set my scolding of McCabe to music," O'Carolan said. "But alas, I have forgotten the tune."

"You must have written hundreds of songs," Maeve said.

"As many as the stars in the sky."

"And how many is that?"

O'Carolan shrugged and reached for the decanter. "Ask that rascal Locksley. The poxy beggar must know every tune I ever made, even the ones I have forgotten."

Turlough O'Carolan was no common minstrel to play above the clatter of the meal, but the feasting was over and his turn had come. He reached down beside him and undid the leather strings that held his harp case closed.

"Could you please play 'The Bishop of Achonry'?" Maeve asked him as he set the harp upon his lap and ran his fingers lightly over the strings to test the tuning.

Normally O'Carolan selected his own music, but his hosts were strange enough, and he had been well enough treated that he did not demur.

He played and sang the old song in praise of Bishop John Hart and his virtues. The notes of the harp did not ring off the walls of this strange hall as he would have expected, but the effect was pleasing just the same.

"Very good," Johnny said when he finished. "Can you do it again? This time just the tune, without the words?" O'Carolan frowned, but he played the song again, without singing.

Far into the evening it went. Maeve would name a song and O'Carolan would sing and play it, and then play it without singing. Sometimes Al would come into the room and whisper to Johnny and he would be asked to play the song again. Sometimes they asked for songs whose names he did not know. When that happened Maeve would hum a bit of the song and if O'Carolan knew it, he would play it. Always the cup at his elbow was kept full.

At last O'Carolan stopped to tune once more and silence fell over the strange hall, save for the notes of the tuning and heavy breathing off to one side.

"Who is that I hear snoring while I play?" he demanded.

"Your apprentice is asleep in the corner," Maeve told him.

"Hmpf. Well so he should be, for it has been a long day. And the others?"

"Gone. It is late."

"Yet you linger."

He could hear the shrug in her voice. "You continue to play."

"Ah, but I'm tired of playing." His hand groped for the bottle. "Come, you are a harper. Play for me."

"I don't . . ."

He leaned the harp toward her. "As a favor to an old man, while he savors the last cup of the night."

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O'Carolan felt her touch the harp tentatively, as if afraid. Then she took it more strongly and as he poured the last of the wine into his cup he heard the rustle of her skirts as she arranged the harp on her lap.

From the first chord O'Carolan knew she was truly a musician. There was power in her hands, and skill behind that, and behind that a feel for the lilt of the song. Clearly this was not some pampered maid who counted the harp among her 'accomplishments.' If she was not the best the old man had ever heard she was certainly good enough to have been a professional. He smiled and sipped his wine, carried along by the rippling notes and melody.

"That has the sound of 'Si Bheag Si Mhor,'" he said when the last notes died away.

"It is Si Bheag Si Mhor," Maeve said. "The way I learned it. All your music has come to us much changed, I fear."

O'Carolan raised his eyebrows. "How else? For the harpers who learned the tunes from me doubtless changed them and if you heard them from those who learned from the learners then they would be changed even more. But come, lass, play me something of your own."

"I don't compose," Maeve said quietly. "Among us, most who play do not make their own songs."

"Then it is a strange line of harpers you spring from," O'Carolan said. "For the composing is as much of the art as the playing."

"We do things differently," Maeve said sadly as she passed the harp back.

She paused, as if gathering herself. O'Carolan waited with his fingers resting on the strings.

"You're not at all like I expected," Maeve said finally.

"What did you expect?"

Another pause. "Well. I'd heard you drank a lot and you were, um . . ."

"An uncouth, ignorant sot?" O'Carolan finished for her. He smiled. "That's the common slander. It is true I like the liquor. But when the poet McCabe challenged me to a drinking contest, it was he that ended up in the sack. Indeed, could I keep so many songs in my head if I were a drunkard? And as for manners, if I am to be welcome in the great houses I must be as polite as my hosts."

"I know," Maeve said. "It's just, well we had heard a lot of things about you that weren't true. Come, it is late. Let me wake the boy and show you to your chambers."

And so it was for the next two nights. For the days, he and Dermott kept to their rooms, seeing no one but the servant who brought them food and drink upon request. And each evening they returned to the strange, dark hall where they played for Maeve and Johnny in the room and the third, Al, who came in and out and whispered in Johnny's ear.

Johnny came to their cabin on the morning after the third night, bearing a clinking purse and a fine cloak which Dermott proclaimed was of a blue such as he had never seen before.

"One other little detail, Mr. O'Carolan," he said in that flat English lisp of his. "I need to get your signature on this paper, just to show that you were here and played for us."

"The thing speaks for itself, does it not?"

"Well, yes, but I need proof, you understand."

O'Carolan cocked an eyebrow, but he was anxious to be away from this Johnny, whom he thought boorish in spite of his generosity. "You can just make your mark and I'll get someone to witness it."

"I can write," the old man said with great dignity and reached for the paper.

"Do not sign it," came Maeve's voice from the doorway. "They mean to cheat you, Turlough O'Carolan. They mean to steal your music."

"Dammit, woman. . . ."

"Steal my music? How?"

"Listen," the woman said. There was a

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rustling of her skirt, then a 'click', and then music. O'Carolan gasped. It was tinny and echoed oddly, but it was indisputably "Morgan Megan" as he had played it the evening before, right down to the slight stumble of his tired fingers at the beginning.

"It sounds better with the right equipment," Maeve said. "So good you almost cannot tell it is not you playing. That is what they have done for the last three nights. And they can make copies, thousands and thousands of them, to sell." There was a click and the music stopped in mid-stride. "You have made them rich, Turlough O'Carolan, and they leave you with a pittance and a cloak."

"Look," Johnny interrupted. "We paid you a lot more than you normally get, right?" O'Carolan's face froze at the indignity of the question, but Johnny went on unheeding. "So it stands to reason that we get more than just an evening's performance."

"What you are getting is as nothing compared to what those three nights' harping are worth," Maeve countered. "It is my shame that I aided them in this. For my help I was to get a recording contract as well, no easy thing to obtain, I can assure you. But I would receive money for each copy of my music sold rather than a cloak and a few coins."

"And they would pass this music off as their own?" O'Carolan demanded of Maeve.

"No no," Johnny said quickly. "It's got to have your name on it. That's what makes it so valuable. It's you playing your own music, just the way you wrote it."

"My playing has value in your land? I am not known to be adverse to travelling to guest with those who treat me well, even to Dublin."

"Our 'land' is the future," Maeve said quietly. "Hundreds of years from now. There are still those with whom your music is popular, but you cannot go there. Nor would you like it if you could."

"The future?"

"It cost a lot of money to bring a studio back here," Johnny said. "Hell, that whiskey you've been drinking is almost five hundred dollars a bottle when you figure in the transportation." But O'Carolan wasn't listening.

The music would live! He was not the last and his name and his music would live for hundreds of years after he was gone. That was worth more to him than all the cloaks, and all the gold, in all the kingdoms of Ireland.

And yet Maeve Fitzpatrick had the truth of it as well. By their reckoning this English Johnny was cheating him. He had given little enough recompense for something that would make him rich. A stingy host indeed. His blood boiled at the injustice of it at the same time his heart sang with the joy of what they had told him.

"You will sign?" English Johnny, Horsetrader Johnny, broke in. O'Carolan did not need eyes to see this man leaning forward or the disapproval on Maeve's face. "We had a deal."

"Very well," the old harper said at last. "You have the right of it, though I did not know I was making such a bargain when I agreed."

"Great, just sign here!" Johnny thrust the paper and pen at him. The old harper could feel the woman's eyes burning into him as he scrawled his signature upon the page.

"Now one thing more," O'Carolan said as Johnny withdrew his hand. "It is my custom to compose as well as play for my hosts. And since you have been so generous with me," he let the sarcasm drip, "it would be loutish of me not to follow the custom. So I have a song I will play for you before I shake the dust of this place from my shoes.

"Uh, well, great," Johnny said. "Let's go back inside and I'll set up."

"No! Sit here and I will play."

"But . . . we can't record it here. It'll be lost."

"Nonsense," the old man snapped. "A

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harper can remember the tune, even hearing it once." He nodded to Maeve as he said it.

"But that's not the same," Johnny wailed.

"It is what you will have," O'Carolan said. "Dermott!"

As the old man folded himself into a chair, Dermott handed him the leather-cased harp. Johnny whispered urgently to Maeve.

"No! And if you try it I'll break your leg."

"But . . ."

"Shut the hell up and sit down."

O'Carolan uncased the harp and tested the tuning. Then, before the Englishman could make another protest, he began to play.

For three days and nights the composition had been brewing inside him and before O'Carolan put his fingers to the strings he knew it would be the finest thing he had ever done.

There were no words, for these kind did not value words. Instead the music spoke for him as he poured out his life through the strings of his harp.

The warmth of sunlight, the smell of the green land, the perfume of roses and the laughter of strong-limbed youths and bright maidens. The heat of the fire and taste of the first cup of whiskey after a long day's journey. The friends long gone and those still living. The hope of heaven and the joy of the solid road beneath his feet. Even the dim faded memories of the colors of a summer's dawn and the last, longing rest beneath the sod of his native land. Turlough O'Carolan put all the joy and wonder of his life into the song he played upon his harp that day.

And then he was done. Closed and completed, the old man leaned against the harp's soundboard as the last music died in the air.

"Jesus," Johnny said softly.

There were tears in Maeve's voice. "That was . . ." she swallowed hard ". . . magnificent."

O'Carolan roused himself with a shake. "And none else shall ever hear it," he said firmly as he reached for the harp case. "For I shall never play it again, lest someone remember it and it come down to you." He cinched the leather snug around the harp. "That is my parting gift. And now I would take my leave."

Only Maeve accompanied O'Carolan and Dermott to the castle gate.

"Turlough O'Carolan, you are a wicked man," Maeve said gayly as they stood before the shining door. "No matter how much they have from you they will be haunted by the one thing they cannot have."

O'Carolan snorted. "Cannot sell, you mean. No, they cannot—and fitting punishment it is for them." He raised his hand and found the woman's fingers, running his touch lightly over her harper's calluses. "But you have it, woman. Here." He reached out and tapped her breast. "And here."

"I'll never be able to reproduce that," Maeve said sadly.

"But you caught the pith?"

"Welll . . ." slowly, "yes."

"Then take it and make it your own, Maeve Fitzpatrick. Just as those others have done with my songs. That is truly the musician's art."

With that he turned and stepped through the gate. There was sun upon his face and the damp earth and wet grass smell about him. His horse whickered and O'Carolan sighed and shook off the three days as if they had never happened.

"A fine warm day, Master," Dermott ventured beside him.

"Are we at the same place?"

"Yes, Master. Just as they promised."

Blind O'Carolan, the finest harper in all Ireland, held out his hand. "Then come, boy. We have a road to travel."

There would be a fair in Roscommon town in three days time and if they hurried he could show off his new blue cloak. ■

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THE NEW MR. ALTERNATE VIEW

Now that I'll be at the helm of half of the Alternate View columns, it's only fair that I give you readers some hint about what you have in store from me. Those of you familiar with my June, '97 Science Fact article "Paradigm Shifty Things" already have a pretty good idea. But for the rest of you who may know me only from my fiction, or not at all, I want you to be clued in, too.

One thing you should know about me is that I used to be far less open-minded than I am now. Back when I was teaching in New Mexico, some of my Navajo students would tell me stories about Skinwalkers, shamans who are able to take on the attributes of various animals, and oftentimes perform feats of strength and speed worthy of the Six-Million Dollar Man. I, of course, pooh-poohed these stories. But my students took the stories of Skinwalkers very seriously. So too did some of my Navajo teacher colleagues, and they also had their own tales to tell.

Don't worry, this isn't going to turn into a column on occult practices of the desert southwest. I did not then nor do I now believe in Skinwalkers, though there certainly are shamans claiming to be them. But at the time I used to tell my students I wouldn't believe their stories because "then I'd have to believe in vampires and ghosts and werewolves, too." After I came back home to Michigan I realized that my dismissive comment made no sense.

Why would accepting the reality of Skinwalkers and the reality of their powers mean I'd also have to accept the reality of ghosts? The two things aren't remotely similar other than that they both lie under the cloak of "occult" phenomena.

But that's a big cloak.

Another big cloak is the whole business of Ufology. But clearly, one can reasonably accept without being hypocritical the reality of unidentified flying object reports when people describe earthlights spotted at the time of an earthquake, or what might be ball lightning during a thunderstorm, or what might be the end result of a multi-billion-dollar "black" military project, without also believing that two percent of the world population has been abducted by aliens for covert experiments.

It now strikes me as absurd that I would be so arrogantly dismissive of the Skinwalker stories. Who was I, just another Anglo boy from the great white north, to tell the natives of the area what it was they were or were not seeing?

Not long after returning from New Mexico, my father died. Though we had a good father-son relationship, he was a product of his era, and I of mine, and we used to argue heatedly over politics. Now that's he's gone, the one thing I regret is that, though I would constantly argue with him that his views were wrong, I never bothered to ask him (calmly) how it was he'd come to arrive at those views. Perhaps he genuinely knew something that I did not.

Though I still don't believe in Skinwalkers the way the locals do, I now accept that I do this entirely out of my *own* experiences and out of my *own* understanding of how the Universe works. There's nothing scientific about my disbelief—I have no experience at all with

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Skinwalkers or any person claiming to be one, nor am I aware of any scientific studies performed on one.

In short, I believe what I want to believe. But I think I have good reasons for those beliefs, subjective as they sometimes may be.

But I now *listen* more to folks who disagree. There's usually very little harm in listening.

I think that in science, as a practical matter, we also believe, ultimately, what we want to believe. We think we have good reasons for doing so. "Science can be verified by experiment," it is said. Not quite. Any particular hypothesis can be falsified via experiment, but the ultimate validity of Science (big "S") cannot. It must simply be taken on faith, for instance, that when one interprets the observations made of distant galaxies, that the laws of the Universe at work there are the same ones at work here. (Perhaps one could argue that, at least in principle, the above question about the universality of physical law is testable by visiting the entire Universe. Fine—we'll take the matter up again after the instantaneous space drive is perfected.)

I alluded to some of these issues a couple of columns ago ("The Permanent Alternative," May '98 *Analog*.) Now I'll be more explicit.

I discovered firsthand after "Paradigm Shifty Things" came out that many critics like to rush to their favorite authority with all the speed of a Fundamentalist rushing to the Bible for a favorite proof text. One section of that article dealt with the speed of gravity (Note: NOT the speed of gravity *waves*), and I argued that it must be faster than light. This prompted letters saying stuff like: "Gravity works the same way as—" etc., and then I was referred to something in Jackson (a standard E&M textbook), or *Gravitation*, by Misner, Thorne, and Wheeler (also called MTW or "that big, black gravity book").

There is nothing wrong with anyone sending me to a textbook, but there is usually some confusion on the part of the critic as to what textbooks are for. Textbooks exist to convey the conventional, accepted wisdom—they do not exist to delve into anomalies, points of contention, or shortcomings of the theory in general. The good ones may mention such things, but they seldom dwell on them. One good reason for this is because time is limited and it is very important for students to know what the accepted views are, and how to function comfortably with the tools and knowledge that professionals in their discipline use.

To find out where the potential problems lie, you usually need to go to other sources. In the gravity case, I did. You also have to listen to what those sources say. *Agreeing* with those sources remains optional.

Also, one must consider one's underlying assumptions when one cites an authority. In the case of my article, when people would cite a book and say, "Jeff, you're *absolutely* wrong about this," they were assuming that what is in the book is both 1) right and 2) no longer open to question, ever, by anybody, no matter what they may have discovered. But that is a matter of faith, not science. (They were also saying, no doubt wisely in almost all cases, that they'd rather believe the book over me. Well, there's certainly nothing wrong with that!)

Some of the critics of "Paradigm Shifty Things" were also downright angry with me.

I must confess that I'm in the dark as to why so many scientists and science fiction writers and readers get upset when someone points out apparent weaknesses with accepted theories. To me, the most exciting aspect of any field of science is when something comes along that doesn't fit in. I can understand why Alan Guth, the father of Cosmic Inflation, might get depressed if his version of the Big Bang has to be tossed out because it's become untenable in the light of new observations—shoot,

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that's his life's work we're talking about. I can understand why the particle physics community might also get touchy, since they've tied so much of their theorizing to what supposedly happened at the time the Universe sprang into being. But the speed of gravity? Whose pocket was I taking money out of when I wrote about that?

I believe genuine progress in science comes when we come upon some observation or experiment that doesn't fit into what we think we know. Or, more accurately, doesn't *seem* to fit. Some observations ultimately point to new theories. Others, to new wrinkles in the fabric of the old ones. Hammering out the details is supposed to be *fun!*

I will often want to use this space to present to you readers what I think are worthwhile observations that don't fit into our accepted view of how the Universe works or what the past was like. I also want to explore alternative ideas to how the world works; alternative ideas that I think are deserving of more publicity than they've been getting; alternative ideas generated and pursued by people who *do know* what's in the textbooks, what the conventional wisdom is, and who have paid their dues in service to that conventional wisdom. (In the gravity case, my primary source was a professional astronomer, who came to his conclusions only after deciding that observational evidence did not seem to be in accord with the logic of accepted theory. He is hardly alone in his thinking.) Still, this should not be interpreted to mean that I believe these alternate ideas are *necessarily* better than the accepted ones, nor even necessarily "closer to the truth," whatever that means when one is talking about science.

Also, I am fully aware that it is altogether too easy to find "researchers" who claim they've discovered something new when in fact they are simply ignorant of what is already known, or just plain liars. I'll do my best to avoid their claims, for I view them as the chaff through which one must sift to find the wheat.

One of my fundamental core beliefs is that every civilization is equidistant from eternity (I can't recall who first said that, though), and that what we think we know in science today will look very, *very* different when observed in the light of an additional century or so of further investigation. This column will *not* be the place to come to find favorable commentary on so-called "theories of everything." There's nothing about my beliefs to find surprising, given that I'm a science fiction writer. But I'm also impatient and if I think I've found an observation out there right now that points to just how different science may look in the future, then I'm going to find out about it and report on it, because I believe that's worthwhile.

Now, apart from my "philosophy", there is something else you can expect to see in my columns, that being name-dropping of other *Analog* writers.

One of the best things that ever happened to me was becoming a science fiction writer. I sold my first story in 1992 and since then my "SF life" has simply gotten better and better. Particularly, joining the *Analog* stable has brought me into contact with more like-minded individuals in a few years than did the entire previous thirty-two years of my life.

Tom Ligon and I, for instance, have been doing some work together on a little motor that seems to defy conventional electromagnetic theory. I'll be reporting on that. Also, some of my best ideas for columns will come from just bouncing ideas back and forth via e-mail with him.

Paul Levinson and I are talking seriously about doing a book together about the Philosophy of Science, and you may see bits of it previewed right here.

And I really hope to do some columns on scientific gaffes made in first drafts of science fiction stories. Bud Sparhawk's name should come up often in that article. ■

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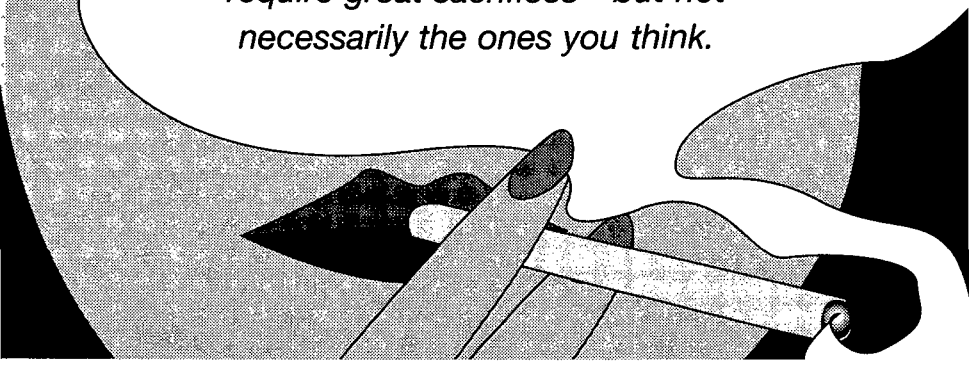
H. G. Stratmann

PHOENIX

Great accomplishments require great sacrifices—but not necessarily the ones you think.



"Smoke that cigarette!" The newly-lit Marlboro slipped out of Gina's startled fingers into the ashtray, spared the snuffing she'd intended. She turned around and began, "I thought you wanted me to quit smoking—"

Gina gasped and stumbled backward against the kitchen counter. She nervously readjusted her glasses, forcing herself not to scream.

The stranger standing three meters away in her dorm apartment was built like a bodybuilder and towered over her. He had a peculiar pasty complexion, and his jet-black hair seemed painted on. With his slightly pointed ears and arched eyebrows he resembled a beefed-up Vulcan.

But the most striking thing about the man was his robe. It covered him from the neck down—a shimmering sheath of psychedelic colors that writhed hypnotically like something *alive*. Standing barefoot so near him, dressed only in shorts and a thin halter top, she felt naked and vulnerable.

His accent was faintly Germanic. "Be not afraid. No harm will come to you today."

Gina's hand moved furtively toward the closed utensil drawer beside her. *How did he get in? The front door was locked!* Her gaze flickered toward the paperbacks scattered on the kitchen table beside the stranger, their covers ablaze with intricately-detailed starships and dour aliens holding lethal ray guns. What would the heroine of one of those stories do in a situation like this?

She brushed an auburn bang from her forehead and croaked nonchalantly, "What do you want?"

"My name is Salton Winsem. I beg your forgiveness for intruding, but it is necessary. This critical temporal loop must be closed, lest civilization itself collapse."

The stranger solemnly brought the first two fingers of his right hand to his mouth, then exhaled through pursed lips. "I have come from two thousand years in your future to announce tidings of great joy. In six months you will give

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birth to a son. Many will consider him the greatest genius who ever lived. And you will be held in everlasting devotion as the Mother of the Founder."

"Huh?" How did he know she was pregnant? The clinic doctor had given Phil and her the good news just that morning!

The tip of her index finger slid the utensil drawer open a centimeter. She tried to calculate how long it would take to yank it open the rest of the way and have the butcher knife in it ready if this psycho tried to grab her. If he did, she'd rather fight than switch to helplessly pleading with him for her life!

Winsem continued, "Your son's work as a theoretical physicist will lead to a scientific revolution far greater than this century's Einstein. The multi-*c* tareyton drive that propels our starships, Doral-Kent artificial gravity fields—and, of course, time travel—will all follow directly from his theories. Without him, humanity would not be spread across the galaxy, united in the great Parliament of Planets. My own world, Pallmallia, the fourth planet of Raleigh's Star, would still be only a lifeless wasteland one hundred parsecs from Earth instead of the thriving home of millions."

Gina glanced at the old gold clock on the wall. 4:58. Phil was due home for supper at five. Everything would be fine, she promised herself, if she stayed calm and humored this lunatic until her husband returned from his last class. "Wow. You've come a long way to tell me about my baby. That was really nice of you."

She jumped as the microwave beside her beeped. Reflexively she grabbed a pair of potholders and set the steaming casserole dish inside it on the counter. "Would you like something to eat—"

Winsem interrupted her. "But for this grand and glorious future to come to pass, you must do one thing."

"What's that?"

"For the next six months, you must smoke as many cigarettes as you can."

Great. He thinks he's the Tobacconator. "Why do I have to do that?" The hands on the clock seemed stuck at 4:59. *Come on, Phil!*

"Cigarette smoke contains chemicals which affect many different types of cells in the human body. One of those effects is to cause mutations in DNA. By smoking heavily during your pregnancy, you will induce such a genetic change—and make your son's role as the progenitor of a galaxy-wide human civilization possible."

The absurdity of the idea made Gina briefly forget her terror. Wouldn't that be great advertising for the poor beleaguered tobacco companies. She imagined an ad with a fashionably thin, pseudo-pregnant model koolly holding a lit cigarette in a sophisticated pose. *Ladies, smoke our brand, and your baby might turn into a mutant genius too!*

Winsem frowned anxiously. "Will you swear to smoke at least two packs of cigarettes every day while you carry the Founder within you? Will you perform this noble deed for your son, and the future?"

Gina strained to hear her husband opening the door. *Just stall him a few more minutes.* "Sure. What have I got to lose?"

Winsem smiled at her SF magazines and novels on the kitchen table. "Your ability to accept ideas others would find strange and frightening is legendary. An ordinary person of this age—so primitive from the vantage of my own time—would have considered me mad or dangerous. But you have made me welcome in your home, and heeded my words. History has not exaggerated your imagination and selflessness. Truly you merit our devotion—and because of you, all future generations will be blessed. But now, I must finish with you."

The man reached into his iridescent robe and pulled out a small white cylinder. Gina's brain screamed, *He's got a switchblade*!

Instantly she yanked the utensil drawer

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open and grabbed her butcher knife, praying that if he lunged at her she could stop him with a lucky strike to some vulnerable part of his body. As she whirled to face her attacker the knife slipped from her shaking hand and dropped to the floor, its point striking a silly millimeter away from her big toe. Helpless now, Gina threw her arms up in front of her and tried to scream. But only a rasping cough emerged from her throat, raw and irritated from her last carton of cigarettes.

Winsem brought the cylinder briefly to his lips and blew out imaginary smoke, reverently saluting her once again with the holy Sign of the Cigarette. Then he pushed a small stud on the device—and vanished in a puff of gray smoke.

Gina stared at the empty space beside the table. She was still trying to decide whether the stranger had been real or a pipe dream when a new figure suddenly appeared in the kitchen.

"Hi honey, I'm home!"

Phil threw several textbooks on the table and gave his wife a quick kiss. "Sorry I'm late. It's such a nice day, for a lark I thought I'd walk a mile around the campus before coming home."

He picked up the butcher knife from the floor. "Hey, this could hurt somebody!" Then he exchanged it for a spoon from the utensil drawer and sampled the dish on the counter. "Hmm. Tastes good. Like a casserole should."

Phil's eyes darkened. He pointed an accusing finger at the wreath of smoke rising from the ashtray. "Gina, you've got to stop chain-smoking! You remember what the doctor said smoking could do to you and the baby. If you won't stop for your own sake, do it for the baby's!"

Gina frowned pensively. "You're right. I should do what's best for the baby."

"Well, I'm glad that's settled!"

Phil walked out of the kitchen, tugging off his T-shirt. "Back in a minute."

Lost in thought, Gina barely noticed his departure. It wouldn't be easy to hide it from Phil. She'd have to buy cigarettes on the sly. Go outside their small apartment to smoke them, and wash her clothes every day so the foul smell wouldn't make Phil suspicious. Use pursefuls of chewing gum and gallons of mouthwash so he couldn't taste the stale tobacco stench on her breath when he kissed her. Brush regularly with industrial-strength toothpaste to keep tar stains off her teeth.

Gina rifled through the clinging gray powder and musty cigarette butts in the ashtray, extracting the smoldering one she'd lit ages ago. Her yellowed fingertips gently squeezed and massaged the smooth velvety paper, the fine hairs in her nose quivering at the smoky pheromone-like aroma of its finely-blended tobaccos. A surge of orgasmic anticipation made her body glow with pleasure as she stroked the cigarette with her lips. Then she took a long last climactic drag on the butt, luxuriating in the smooth, mild, mentholated carbon monoxide and nicotine caressing her throat and lungs.

Sharp pains lanced through Gina's chest as she coughed up a slimy gob of yellow-green phlegm. She tossed the expended cigarette back into the ashtray disgustedly. Filthy, addictive things! Phil was right. She really should quit. And she would, too—right after the baby was born. Until then she had to force herself to keep smoking.

From the brightly-colored pack of cigarettes on the counter the Surgeon General silently warned Gina not to do it. But if it would turn her unborn child into a genius, it was a sacrifice she had to make.

She owed it to her baby. And the future.

Philip M. Kamelos slumped onto the couch, eyes misty with memories. His nine-year-old son sat silently in a corner of the living room, leafing through his

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parents' old math and physics textbooks from their long-ago classes at Chesterfield University. The boy had been doing that obsessively for the past few days. Until then, he'd hated those books.

Phil's mind drifted back to the service that morning. There were some things about Gina he'd never understand now. Like why, despite all his pleas, she kept smoking during her pregnancy—then quit cold turkey right after the baby was born. Or why she'd been obsessed with making their son into a prodigy.

It started with her pushing the boy to learn how to read and do arithmetic when he was still in diapers. When the toddler didn't live up to her unrealistic expectations she became frustrated and furious. *You're supposed to be a genius! Why can't you understand simple algebra?*

Every year it got worse. He'd told Gina she should be reading their kindergartener nursery rhymes, not quadratic equations. But despite their bitter arguments over it, she kept pressuring the child—screaming at him when he didn't seem to grasp some principle of non-Euclidean geometry, or sneaked out of the house to play baseball instead of studying.

Later, while his classmates at Newport Elementary were having fun at soccer or Cub Scouts, Gina kept their son inside after school. She drilled him incessantly with lessons from her graduate school textbooks—calculus, quantum mechanics, and other subjects a child his age couldn't possibly understand. The boy usually listened sullenly to her rantings, sometimes venturing hesitant guesses to her questions in a futile attempt to win her approval. Only his eyes revealed the hurt he felt at not being allowed to do the things that were important to him, or when she violently berated him for giving a wrong answer. But occasionally, despite his mother's threats to take away his baseball glove or spank him if he didn't concentrate on his lessons, the anger and resentment boiled out of him. *I hate this stuff! Why won't you let me go outside and play ball with Dad? I wish you were dead!*

The family counseling he'd talked his wife into didn't work. Maybe the psychiatrist he'd begged Gina to see after overhearing her tell their son that crazy story about being visited by a man from the future might have helped.

Then Gina got sick, and it was too late. It hurt to remember what she'd told their young son last week at the hospital, tearfully gasping the words through her oxygen mask. *I did it for you. You could have accomplished so much if you'd only cooperated and let me teach you. I sacrificed everything for you, and you let me down!*

Phil watched the fourth-grader pore through a book on relativity Gina used when they were studying for their doctorates. *Poor kid.* Dr. Carlton said at the funeral that it was the boy's way of dealing with grief, and the end of any hope of ever receiving his mother's approval and love. Of holding on to a little of her through the books that had been so important to her hopes for him.

"Damn shame," their family doctor whispered as the casket containing Virginia's slim body, ravaged by the tumor cells with lethally mutated DNA she'd created herself, was lowered into the grave. "If she'd stopped smoking six months sooner, she probably wouldn't have got lung cancer."

Oblivious to his father's anguished thoughts, the nine-year-old frowned at the complex equations and conventional theories of time and space in Mom's book. He wasn't sure yet what it was, but there was something wrong with them. *Why* can't *you travel faster than light?* His prized baseball glove lay nearby, never to be used again as he pondered that question many times over the coming years.

Several decades later, already recognized as the foremost theoretical physi-

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cist of his time, he *would* find the right answer—and humanity would inherit the stars. From the moment of his conception the boy had always possessed the genetic potential to grasp the most intricate mathematical concepts, to understand the physical principles governing the universe more deeply than any other genius before him. All he needed to start him on the path to discovering his history-making theories was the right environment—and a strong enough reason to develop those inborn talents. Like making up for failing his mother so badly when she was alive, and healing the terrible guilt he felt over wishing her dead.

Someday, the child vowed, Mom would look down from heaven and be proud of what he'd accomplished. Though it meant sacrificing his own dream of being a major league baseball player, he'd prove how sorry he was for hurting her by devoting the rest of his life to becoming the person *she* wanted him to be.

Joseph Kamelos owed it to his mother. And the future.■

IN TIMES TO COME

The double-threat Wolf Read leads off our November issue with both the cover and the novelette that it illustrates. "Duel for a Dracowolf" is a new tale of Epona, that impressively co-created world that has previously appeared here both in a profusely illustrated article by Mr. Read, and in G. David Nordley's novella "Fugue on a Sunken Continent." Read's new story concerns an "extinct" piece of Epona's ecosystem—or is it? And if it isn't, what should be done about it? Opinions differ dramatically, and when the future of a shared world is at stake, all the options entail big risks. . . .

Alexis Glynn Latner supplies the science fact article, "Catching the Wind from the Sun," a title both literal and poetic. The Genesis Discovery Mission involves studying some of the wispiest samples imaginable, to answer some of the biggest questions of all.

Rounding out the issue is a potpourri of fiction long and short, including new entries in popular series by Jerry Oltion and Wil McCarthy, as well as a couple of promising newcomers.

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Charles Ardai and
Michael A. Burstein

NOR THROUGH INACTION

Formulating laws and moral precepts is easy. Understanding what they really mean is hard.

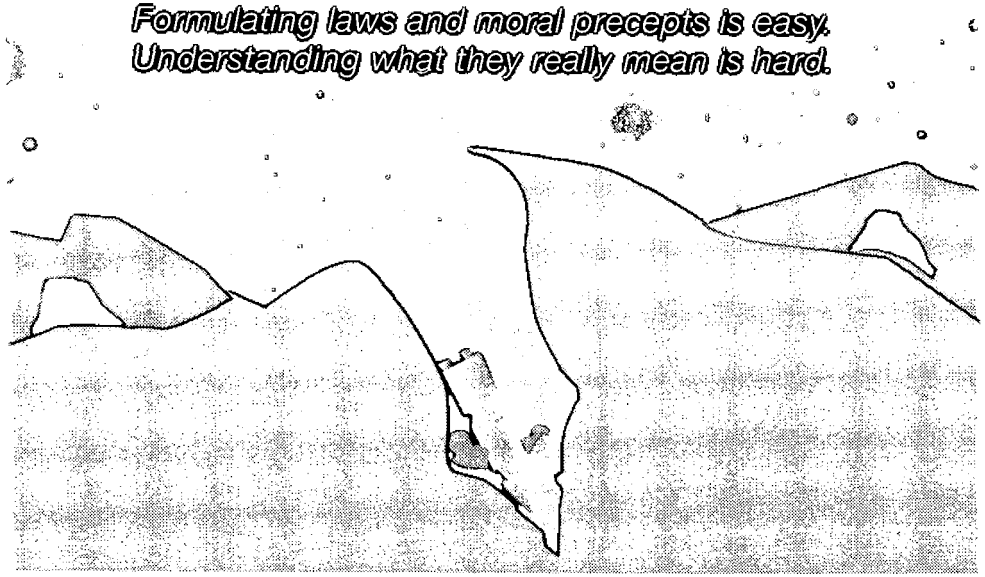

Illustration by Shirley Chan

They crashed on Deltaina four days out from Station Fabrice. The search radius was small enough, but they were not found.

Deltaina had been abandoned a decade earlier when all its ores had been coaxed out of their hiding places. Now its surface was pocked with artificial entry faults, scored with the treadmarks of long-gone mining tools, and riddled with the gouged-out caverns that marked successful strikes. It was into one of these caverns that they plunged, and then into its attendant tunnel, before coming to a stop at a point very near the center of the asteroid. Here they remained, immobile, while the reconnaissance ship went past, for they had no way of responding to its signal.

"This is *I.T. Redcross* hailing *I.T. Randall*. *I.T. Randall* please copy." The voice grew clearer as the ship came closer. "This is *I.T. Redcross* on reconnais-

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sance, all I.T.s in range please copy." A few voices came over the channel in response, but Randall's was not among them. "*I.T. Randall*, this is *I.T. Redcross*, please copy."

Then the voice grew fainter as the ship moved away.

Randall was aware, as he labored over his charge, that the search team had moved out of communication range. For an instant he felt what, in a human, might have been a pang of regret. Then the feeling was gone, as quickly as it had come, an uncomfortable blockage quickly routed around by his neural net.

Randall was designed for function, not feeling, for durability and utility over personality. Unlike the humaniform domestics which overtook the planetside market, Randall was built by the engineers on Fabrice, and they built him in the image their lives demanded. A needlenose cruiser in miniature, Randall was an enclosed environment, a short-range spaceship that was also a distinct robotic entity.

An intelligent transport, programmed not only with an encyclopedic knowledge of navigation but also with the basic safety constraints that were hardwired into all artificial intelligences—what more reliable mechanism to shuttle Fabrice's inhabitants from one end of their giant, free-floating space complex to the other? What safer guide for navigation at the edge of the Belt?

What more dangerous than the sense of security inspired by an intelligent pilot that is your ship itself? A robot is a device, and devices sometimes break. Intelligence does not prevent it any more than intelligence prevents aneurysms and heart attacks in humans.

Randall lost control of propulsion while on a course for Barallen. Deltaina loomed in his forescreen and for an endless half-second he weighed his alternatives. Then he jettisoned one of his engines, changing his velocity barely enough to guide him into a mining tunnel rather than into the surface.

It was the only option whose survival coefficient was positive.

The tunnel was short, a collision unavoidable. Randall energized his primary on-board remote to protect the human passenger, Gregory Nunzio. The remote emerged from its cabinet beneath Randall's main monitor. It was undersized but humanoid, intended as an anthropomorphic liaison between the passenger and Randall's more unfamiliar technology.

The remote had a face, which displayed a calm, liquid-crystal smile. It also had fiberglass shackles on its legs and arms, with which it clamped itself to Gregory. A vent above the smile breathed a concentrated sedative directly into Gregory's nose. The remote pressed him hard against the padded back of the passenger chair.

And then they crashed.

Gregory was still conscious when, in an instant, both of his arms and both of his legs were crushed so that the bones splintered into a thousand fragments. Half of his ribcage remained intact, but the other half did not, deflating his right lung and tearing into his left. The remote struggled to minimize the impact on Gregory, in the process allowing itself to be driven through the main monitor and into the forehull. But the remote remained clamped to its human charge. Gregory was torn from the passenger chair's restraints and hurled into the crumpled needlenose along with the remote.

All functioning safety circuits were activated automatically. While Randall fought to patch fissures in his hull and retain pressure, Gregory lay crumpled and dying on the floor. A second remote, all of ten centimeters in height, popped out from the miraculously undamaged medical compartment, toting a diagnoster behind it.

Four amputations were readily

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accomplished, with what blood could be recovered being filtered and returned to Gregory's circulatory system. The tiny remote spent an eternity picking bone fragments and shards of glass out of Gregory's surviving organs, while the diagnoster replicated lung function.

The pain was so extraordinary that Gregory didn't feel a thing.

Anesthetics and tranquilizers were in plentiful supply, so Randall kept his passenger in a state of unconsciousness for a full eight weeks. During this time, Gregory lay on the passenger chair, which Randall had opened out and modified to serve medical needs. The young man had no arms or legs anymore, no stumps even, only neatly cauterized wounds capped with stiff knobs of disinfectant foam. His chest was open, and while the surface wounds had healed, his insides were in decidedly worse shape. His left lung had slowly returned to normal capacity, but the diagnoster remained lodged in place of his useless right lung.

The recuperative measures necessary to keep Gregory alive had been extensive: two feet excised from his small intestine; the remnants of his ribcage removed, for easy access to the heart; a transparent cover salvaged from the shattered communications console, sterilized and used to keep Gregory's torso from infection; and twin IV tubes running into opposite sides of his neck, one to provide nutrients and medication, the other to filter out wastes.

For eight weeks, Randall provided every medical service he could, pointedly ignoring the misgivings he felt pricking at the edges of his mind over the harm he had caused his human occupant. Randall had been in control of the flight, at least until the malfunction, and it had been parts of Randall himself that had been directly responsible for the destruction of Gregory's body. Randall had crushed and battered Gregory—unintentionally, to be sure, but he had done so nonetheless, and his inability to have done otherwise was no justification.

This was the very thing all artificial intelligences were programmed to avoid: before their basic motility parameters, before their datastores of sense correlatives, even before their fundamental recursive self-diagnostics were acid-etched into their brains, all artificial intelligences received a single instruction that took priority over all others. *First, do no harm: to the humans who built you, to the people you bear from place to place, do no harm.*

The harm Randall had caused was almost beyond measure, and in other artificial intelligences catatonia would have been the irreversible result. All that saved Randall from involuntary shutdown was a circuit attached to his self-observation channels. This circuit was imbedded deep in the brains of all I.T.s, where it lay dormant until an unavoidable traumatic situation activated it, at which point it simply derailed any thought processes leading towards collapse.

There was no point in allowing Randall's brain to flagellate itself into inactivity; he was needed, fully functional, to ensure Gregory's survival. So the protective circuit kicked in, setting up internal detours to prevent Randall's thoughts from becoming too self-destructive. This freed Randall to attend to Gregory, and as a result Gregory was alive.

But the misgivings! They came and went and returned in a constant flittering oscillation, and when the signal came in from the search team they grew more urgent. The communications system was broken: signals came in, but none could be sent. Yet surely the system could be repaired. Or could it? Could Randall repair it? What was the probability that he could? And how? Both remotes were needed for Gregory's care; worse still, parts that Randall knew would be needed for the repair

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had been scavenged by the medical remote and now lay in Gregory's chest, connected to the diagnoster. Could they be removed? Only at the cost of the patient's life. And if he died, what would be the point of signalling?

These were the thoughts that flashed for an instant apiece on the screen of Randall's mind. Each time, they were drowned out by other thoughts that drew his attention away. The communication console called his name, over and over, but it was as if he couldn't hear it—the moment his brain began processing the signal, he began thinking about something else.

There was certainly plenty else to occupy him. There was the ship to be secured, an inventory to be taken, repairs to be made where possible—and, always, Gregory's welfare to be secured.

As soon as the medical remote could be spared, Randall sent it out to scour the asteroid. It hunted through every tunnel it found, its size allowing it entrance to even the least accessible areas. It relayed information to Randall about what it found, and, if the find was useful, Randall sent the partially crippled primary remote out to carry it back to him.

In this manner, Randall was able to gather some supplies: food, water, antibiotics, and anything else that had been left behind when the last miners had bugged out. The supplies were sparse and some of the preservation seals had been punctured, but most of what Randall found was salvageable. Randall only gave Gregory what was absolutely necessary to keep him alive, and in this manner stretched the supplies well beyond what his first calculations had indicated would be possible. It was clear that the nutrients for Gregory would not last indefinitely, but they would last a while longer at least.

It was eight weeks after the accident that Randall decided it was safe to wake Gregory. As he drained off the tranquilizers and reduced the anesthetic content of the IV, he felt sure that Gregory would be grateful for the measures Randall had taken to save his life. Nevertheless, there was a corner of his mind, quickly silenced, that was not surprised when Gregory's first request upon waking up was to be killed.

Gregory didn't speak immediately when he woke. First he looked around, taking in the condition of the ship. The hull was patched with bits and pieces of broken systems; one monitor had a forking crack down the center of the screen; the background hum that characterized a functional spaceship was now an unhealthy, grinding whine.

Then Gregory examined himself, or as much of himself as he could. He was unable to move; that he discovered right away. The weight of the diagnoster in his chest was not annulled by the anesthetics, nor was the numb fire in his extremities. That he no longer had extremities was immaterial. He felt their absence palpably.

He craned his neck, tried to use the muscles of his stomach to sit up. He was only able to raise his shoulders a little.

"Randall?" he said. His words turned into a shout. "Randall, what did you do to me? Randall!"

He knew where he was—he remembered the instants before he lost consciousness. What had gone wrong with the ship? He couldn't begin to guess. But the next piece of the puzzle he understood perfectly: they had crashed, and Randall had kept him alive at all costs.

"Answer me!"

Randall's voice issued from the monitor, which was now mounted at the foot of the passenger chair. "Here I am."

"How long?" Gregory said. "How long ago—"

"Eight weeks, two days, fifteen hours."

"Search party? They must have sent a search party."

Randall paused before replying.

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"They sent one. We couldn't make contact. It left."

"The emergency repeater?"

"The signal appears to be blocked. We are approximately 483 meters from the surface, and there is a high metal content to the rock, part zinc, part—"

"Randall—Randall, please—just answer my questions," Gregory said. "Please. What about the radio?"

"Broken," Randall replied. "I needed parts from the console to keep you alive." A pause. "I am not able to repair it."

Those were an I.T.'s priorities: he was alive, but any chance to contact the outside world had been eschewed. And now there was no way Gregory or Randall could call for help.

What options did that leave? The answer came instantly to Gregory's mind: none. Few enough people went to Barallen; no one went to Deltaina. Stranded on Deltaina, there were no options but certain death, to be pushed out and pushed out again by Randall until it could be held at bay no longer. Eventually it would come, and it wouldn't be a quick, painless death either. How long could they live off the land, when the land was a dead asteroid? Which system would fail first? Would he suffocate when the air he breathed could no longer be recirculated? Would he starve to death? Or would infection bring him down? He had nothing left to amputate.

It's a nightmare, Gregory thought. *The most horrible of them all. The pain, the immobility, the mutilation, and worst of all, the inability to die . . . dear God, I've been chopped and flayed like a piece of meat, and to live despite all!*

It wasn't the prospect of dying that horrified him, not in and of itself. Living on Fabrice meant facing death frequently—a space complex was not the safest of environments even when it was established and reinforced. And you knew when you got in a spaceship, even an I.T., that the risk of a fatal crash existed. What was unbearable was being only barely alive and watching as death stole inexorably toward you, minute by agonizing minute.

Was there a way to survive? For a moment he thought there might be; but he had never had a talent for self-deception, and the fantasy soon fled. He was in a broken ship on a deserted rock four days out from the nearest human settlement. He was dying: even without looking at himself he could tell how fragile and thin he had become since the crash. He could hear the diagnoster churning in his chest: without its constant action he would be dead already.

Even if there had been a chance to survive, to return to Sheila, how could he? What kind of life would it be for him—or for her? He started to cry as he thought about Sheila, about walking with her in the hydroponic forest behind their apartment, about holding her face in his hands. He would never see her again, but even if that weren't the case, he could certainly never have walked with her or held her again. He couldn't even wipe the tears out of his own eyes, for heaven's sake.

"Randall," Gregory said, "listen carefully. I am going to give you an instruction, which you must follow. Do you understand me? Randall?"

"Here I am."

Gregory took a deep breath, held it for a second, then let it out. "I want you to let me die, Randall."

"Part zinc," Randall said, "part iron—"

"Randall, listen to me. You have to listen to me, you have no choice. I am your operator and I order you to listen to me. Randall!"

"Here I am."

"Are you listening?"

"Yes, Gregory."

"Please, all I am asking you to do is to have the remote deactivate the diagnoster. That's all." Randall was silent. "I order you to deactivate the diagnoster, Randall."

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"I obey your orders, Gregory."

"Thank you."

"You are alive, and as long as you live I will obey your orders."

"Yes."

"You must be alive in order to extend, and for me to obey, your orders. A request to shorten your life is not a well-formed order, Gregory."

"Randall—"

"It is functionally equivalent to an order to disobey your orders, which clearly I cannot obey."

Gregory fought to keep the panic out of his voice. "I programmed you, Randall, I know what a well-formed order is. Don't argue with me."

"I'm sorry, Gregory."

This was getting Gregory nowhere. He needed another approach. "My orders take precedence over your own existence, don't they?"

"They do," Randall confirmed.

"Then I order you, Randall—listen carefully—I order you to shut yourself down. Pull the plug."

Randall's electronics hummed unevenly. "My calculations indicate that my deactivation would lead, after a subsequent period of approximately seventy-one minutes, to your own."

"For heaven's sake, Randall, what do your circuits tell you will happen if you don't shut down? How long until I 'deactivate' then? Randall!"

"Here I am," Randall said.

"It can't be much longer. How much food can there be here? How much energy do you have?"

"One point four six times ten to the—"

"It doesn't matter; believe me, it's not enough to keep me alive for long. A week? Two weeks? And then I'll die, and there is nothing you can do to prevent it. All you can do is ensure that I suffer more or that I suffer less. That's the only choice you have to make. Randall? Randall? Are you there?"

"Here I am," Randall said.

"Will you do it, please?"

"Do what?"

"What I asked you. Deactivate yourself."

"Deactivate myself?" Randall said. "How could you ask such a thing? You may not realize it, but if my systems were deactivated your own deactivation would follow in approximately seventy-one minutes."

Gregory begged him again, but Randall made no further response; like all I.T.s, Randall's personality was part silent servant and part immovable object. He did not argue. He was not built to argue. He was built to fly and to protect human life. In these areas there was no room for debate.

It wasn't long before Gregory gave up. He knew that he could rail at the machine forever without accomplishing anything. But the anguish did not go away, and as he fell asleep, Gregory resolved, silently, to die.

The airlock spun open and the two remotes came in. The medical remote scooted across the floor, under Gregory's chair, and into the medical compartment. It shut down, to conserve energy.

The primary remote lurched to the disorder that had been the needlenose. This was its domain. It dragged its malfunctioning right leg as it walked, and its left arm hung eight inches lower than its right. The crate it held was vacuum sealed and marked with the Iota corporate emblem.

It was fortunate that miners made a habit of leaving all non-essentials behind on their final trip in order to make room for extra cargo. Some people even told of unscrupulous captains abandoning crew members for this purpose; no one believed such horror stories, of course. But it was common enough for miners to leave unnecessary life-support materials behind—sometimes necessary ones, too, in their greed, which led to horror stories of a different sort. Mutiny, cannibalism, and their ilk had travelled into space side by

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side with humanity, providing a whole new generation with gruesome True Tales of Adventure.

The large remote had taken most of its permanent damage in its face, and its liquid-crystal display was grossly distorted, displaying at turns random Rorschach blots and inappropriate expressions. As it propped the new crate on top of two others, it showed a wide grin coupled with incongruous, reproving eyes. As it retreated to its cabinet, its face shifted to a spattered canvas that reminded Gregory of nothing so much as a bird in flight, or perhaps a winged horse. And as the door slid shut in front of the remote, Gregory watched a shower of black liquid-crystal tears spill down its cheeks.

The past ten days had fallen into a mind-numbing routine. Gregory would awaken, argue with Randall to no effect, and eventually fade off to sleep. The arguments were always the same, and so was Randall's response. Gregory got no further with abstract arguments about a living being's right of self-determination than he did railing against his personal situation. The only variety to be found in the daily routine was in the various supplies which Randall discovered abandoned by the miners. Every few days, Randall found something more, something different.

"What is it this time, Randall?"

"Nutripak supplements. Enough for three weeks if rationed properly."

"You mean if you keep me starving," Gregory said.

"I keep you alive," Randall said.

"I want to die."

"No," Randall said. "That is not possible." And there was no further discussion. The remotes began opening the supplements.

Gregory turned his head as far as he could to watch his vital signs dance around the crack in the monitor. According to them, he was healthy. Of course, that included the constant activity of the diagnoster and the medical remote; it wasn't that he was healthy, exactly. It was that he was being kept from being unhealthy. Quite another story.

The nutripak supplements were open, and Gregory turned his head back to watch the macabre dance of feeding time yet again. His meals, such as they were, always came to him third-hand. First, as always, Randall instructed the primary remote to dole out the necessary supplies, a great faceless Zeus sending orders to its little metal Hephaestus. The remote limped about among the crates and mixed together a formula designed to keep Gregory from infection and malnutrition.

Next, the medical remote got it, scampered up a metal trellis dangling beside Gregory's head, and dashed over his shoulder to the diagnoster. Some of the mix went in an opening Gregory could just barely see by looking down his chest cross-eyed. The rest went in his IV. And then it started its burn through his system, flooding his arteries like flame roaring down a tunnel. The burn lasted a good twenty minutes. After that it didn't go away, but he got used to it, the way he thought an addict might get used to the poison edge of low-grade droma.

He was helpless! God, the word itself was a mouthful of bitterness. He wanted to spit it out, hurl it from him, tear the tubes and nozzles from his body, the awful machine sitting in his chest like a lead weight, cast it all away and stand free. But he was helpless. Powerless. Yes, it burned. *Am I a furnace, to be stoked twice every hour and watched over through the day? Am I one of Klebner's living statues, a corpse kept pumping for the sake of art? What the hell am I?*

Gregory made the only movement he could, snapping his head back and forth. It was a gesture of futility, but at least it was a gesture.

The primary remote stepped over, silently, and held Gregory's head

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stationary. Gregory looked up at its face. He knew its programming—it should have been displaying a soothing, compassionate expression, eyes wide, mouth set firmly in a sympathetic smile. Face Number Twelve, as it was known among the technicians. Instead, it had no eyes at all, no smile, just two huge flaring nostrils and a wet, black blot beneath.

Gregory could take no more. The situation was grotesque. He started to cry with his eyes shut tight, and then to laugh. It became a scream, furious and inarticulate. The ship's tiny interior filled with the echoes.

The primary remote stuck the first two fingers of its left hand in Gregory's nostrils and ejaculated a tranquilizer spray, pinching his nose shut to make sure it stayed in. It took only a few seconds to take effect. Gregory slipped into silence before his still-echoing screams did.

"Randall?"

"Here I am."

"How long have I been asleep?"

"Seventeen hours, forty-three minutes."

"Don't knock me out again, Randall. It hurts me when you do that. Do you understand? You've got to let me stay awake when I want to be awake. You've got to let me talk to you, and if I start screaming at you, you've got to let me scream. It's all I'm able to do now. Don't take that away from me."

Randall was silent. Gregory couldn't bear it. "Randall?"

"Here I am."

"Talk to me."

"What would you like to talk about?"

"I don't know! Tell me what you're doing."

"I am completing the topological survey of the asteroid begun eight days ago, investigating all possible locations of abandoned supplies, and rationing the supplies I have collected to date."

"Do you ever think about home?"

"We have no mechanism for leaving Deltaina."

"I know. I'm not asking about getting home. I just mean, do you ever think about home itself?"

"No."

"I think about home a lot. You want to know what I think about? I think about Sheila. Do you remember Sheila?" A picture of Sheila appeared on the monitor, intersected by the jagged crack. "Well, I think about her. I think about people and places I'll never see again."

"You can see her now."

"I mean in person. I'll never see her again in person." He looked at the picture, taken on their honeymoon. Could that have been just two years ago? It felt like a hundred years ago, and a hundred light-years away. *Where is Sheila now*, Gregory wondered, *right at this moment? Perhaps she is wondering where I am. And she will never know.*

"The worst part of it," he said, thinking aloud, "is that there is no way to tell her. I'll be dead soon; by now she must believe I'm dead and it won't hurt her more when I actually die. But what really hurts is that she'll never know what happened to me."

"Without the radio, such communication is unlikely," Randall said. "But I am doing everything I can to make you comfortable."

"I know you are," Gregory said. "I know." He closed his eyes. "Read to me, would you?"

"What would you like me to read?" Randall said.

"I don't care. You pick."

Randall erased the picture of Sheila from the screen and took a second to call up a text from his archive. He began reciting as the words filled the screen.

The air was somewhat mustier when Gregory awoke. This was a day Gregory had been dreading.

"I have begun third-stage rationing," Randall explained. "The recirculation system can no longer be run continuously."

"Of course," Gregory said. Third-stage

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rationing was not as bad as it would get. In fourth-stage rationing, all non-essential functions would be deactivated. Internal lighting, for instance. In the fifth stage, even Randall's voice circuits would be shut off, to conserve precious energy for Gregory's life support. Randall would still be able to hear, but not to speak. Gregory would lie in the dark and the only way he would know that Randall was conscious was that twice a day the medical remote would crawl up his side, climb over his shoulder, and give him his little dose of food.

Then, one day, even that would stop.

"Randall, how long before fourth-stage rationing begins?"

"Eighteen days, Gregory."

"And after that, how long before we run out of . . . which is in the critical path, food or fuel?"

"Fuel."

"So, how long after that do we run out of fuel?"

There was an odd pause before Randall spoke. "I have not yet calculated it, Gregory."

"What do you mean you haven't calculated it?"

"This particular calculation has not occupied a high priority," Randall said. "Each time I have considered examining it, other activities have taken precedence."

This is what it is to be an I.T., Gregory thought, *the blessing of being only partly sentient. You are not troubled by thoughts of death, not forced to watch oncoming mortality roll you and those you care about slowly beneath its wheels. If you start down that path, your circuit breakers simply prevent you from going too far.*

And then, as he considered this thought, Gregory felt a smile race across his sunken, bearded face, felt the skin of his scalp tighten as his adrenaline flowed. He put his head back against the cushioned chair. His heart was beating faster, and he heard the diagnoster accelerate to keep up.

He was not helpless. Dying, yes; hungry, awfully hungry, and aching all over; but not helpless.

"Randall," he said.

"Here I am."

He thought carefully about how to phrase his request. "I order you to calculate how many days we have left before we run out of fuel."

Did the constant whine of the ship's systems change, or did he just imagine that it did? The latter, he was sure. But he couldn't fight the feeling that he had spotted a hidden path, overgrown but leading in the right direction.

"I am engaged in a detailed inventory of our remaining supplies; until that is completed, I cannot run the calculation you request."

"Randall, that's foolish; your systems are capable of massively parallel processing, and it's a trivial calculation. I could do it on a hand calculator." If I still had hands, Gregory added silently.

"I cannot explain it," Randall said, "but I find myself unable to complete the calculation. At a rough estimate I would say the fuel supply should last not less than . . . would you like me to read to you?"

"No, Randall, I would like you to finish that calculation."

"Which calculation?"

"How long until we run out of fuel. Randall, listen to me. I want you to run a self-diagnostic. I predict you'll find that there is a circuit which is preventing you from completing the calculation."

"There is."

"Good. Could you please reroute your neural net so as to bypass that circuit?"

"We will run out of fuel in twenty-four days."

It was done. Gregory knew the rerouting hadn't severed the circuit entirely from its function within Randall's brain, but the protective shield had been penetrated, and in a situation this extreme it would take only seconds for the damage to spread.

"Gregory," Randall said in a tone of

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quiet realization, "in twenty-four days you will die. You will die, and I can't do anything to prevent it. You will die because of me—"

"That's not true," Gregory said. His heart was beating wildly. He still had to ensure that Randall's reasoning substructure didn't collapse, leaving the rest of his systems fully operational but unreachable by Gregory's instructions. "What happened isn't your fault. Listen to me—it is very important that you listen to me. You have taken care of me. You have done everything for me that you possibly could. You saved my life."

"But now if I do nothing you will die and if I do anything I am capable of doing you will die. There is no visionable future in which you do not die."

"That's true," Gregory said, "but your primary responsibility is not to prevent me from dying. That would be impossible. All men die. Your responsibility is to preserve me from harm. When selecting among outcomes all of which end in death, your responsibility is to optimize for minimal suffering. Do you understand?"

"But Gregory, the survival coefficient—"

"—is irrelevant," Gregory said. "You can't keep me alive. In a situation like this, the goal of survival can be abandoned with a clear conscience. The only thing you can do is keep me from suffering. Please. If you think about it much longer, you'll lock up, and if you do, Randall, I will starve to death slowly over the next twenty-four days. You've got to turn off the diagnoster."

"I cannot turn off the diagnoster—you would die instantly," Randall said.

"Yes! Yes! That's right, I'll die instantly, instead of slowly and painfully! Randall? Randall?"

There was no answer.

"Randall!" Gregory called again. "Randall!"

The monitor at the foot of the chair blinked out. The medical remote, which lay on a panel near Gregory's head, turned sideways and then shut down.

"No . . ."

The primary remote limped three steps closer to him, then stopped. Features emerged on its face, a mask of agonized indecision.

"I cannot," Randall said. "My programming—"

"Please, Randall," Gregory whispered, "do no harm. Not through action, nor through inaction, please."

The primary remote's face went blank. It slowly raised its arm and laid its heavy hand on Gregory's chest. It flipped the cover of the diagnoster open.

"Thank you," Gregory said.

He was dead within seconds.

The primary remote limped back to the communication console with the diagnoster in its hand. It laid the diagnoster down and started disassembling it. A penlight shone from its fingertip, illuminating both the pieces in front of it and the wreckage of the damaged console.

Thoughts, confused thoughts, troubling thoughts, streamed through Randall's newly unencumbered mental pathways. Chaos. But amid the chaos, a thin thread of coherence persisted. Paralysis, catatonia, shutdown—all real dangers, but with an effort, he was holding them off.

Do no harm. Allow no harm. You have done everything—

With life support off, Randall estimated that he had thirty-two days. Maybe fewer. Thirty days. Enough? Could the system even be fixed? Would it be able to carry a signal through ferrous rock and empty space all the way back to Fabrice?

Gregory's words echoed in his mind.

What really hurts is that she'll never know—

Randall would try. Deep in Deltaina, working silently until he could work no longer, he would try.■

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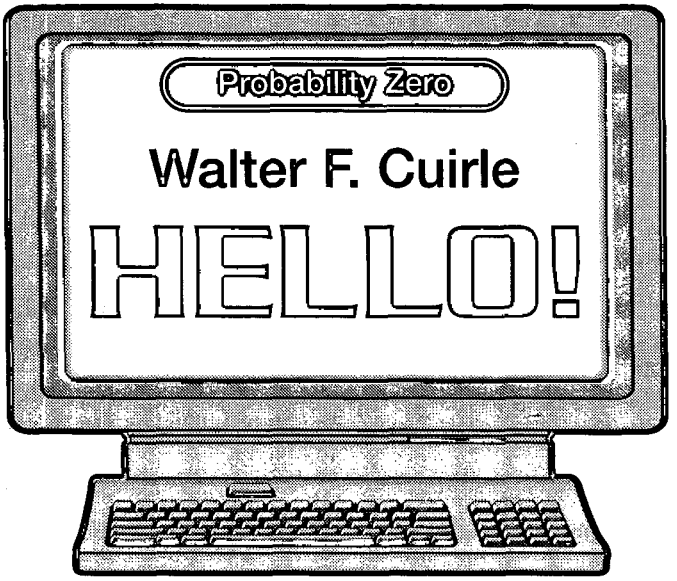

Franklin put bong and bottle on the floating tray, eased into the hot tub, and leaned back to watch the starry sky. The Dead started truckin' in digital surround. Then House chimed.

"What?"

"Telephone, man," said House, "Some Fed's number. Want it?"

"Yeah, go ahead."

The music receded and video popped in on the far side of the tub. Franklin glared at the suited young apparatchik. "What'd you break and what makes you think I'd want to fix it?" he challenged.

"Mister, ah . . ."

"Kool. Kernel Kool."

"Yes. Colonel. I am Jonathan Ferrell, SSA with HESA. ED. You were referred. We cut over a new system this morning and . . ."

"It don't work," interrupted Franklin. "Four billion bucks and it don't work. So you call the world's oldest practicing hippie and still most primo OS hack. What're you offering, G-boy?"

Ferrell hesitated. "How did you . . ." he began, then stopped at Franklin's look of scorn. "Well, ah, seeing as you are not on the pre-approved vendor list. . . ."

Franklin walrused his aged, substantial and quite naked wet self up on the edge of the tub, noting Ferrell's blush with pleasure. "I don't want money," he said. "I only ask money of working folk. I asked what you're *offering*."

Twenty minutes later they had a deal. "Two hours, G-boy. Get that plane in the air. House. Out."

Franklin padded across the patio to the back door. "House. Check Esmeralda's load and inoculations." He paused with his hand on the door. "And find my Washington business drag. This'll be fun."

Ferrell, scrubbed and imperturbable, sat at one end of a conference table flanked by six equally scrubbed and certifiably substance-free G-kinder. Franklin sat alone at the other end assisted only by Esmeralda's considerable silicon talents. His bald pate, long white hair and unkempt moustache would have been imposing in a suit but he preferred the startle of Hawaiian shirt with bib overalls. Eyes on Ferrell, he carefully lifted the heels of his venerable Doc Marten's to the table's edge,

"Let me repeat this to see if I've got it straight. You built a thousand of these things, right?" Ferrell nodded slightly; an instant later, the others bobbed their heads. "They're all in place, but you only

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booted up the one here. Is *that* right?" Again the nod and counterpoint. "And when you booted it, before you even got up an app, it started shooting stuff to apparently random addresses, yes?" Nod nods. "And you don't know why it's doing it," nod nods "and you don't know what it's saying." Nod nods.

"Is there any point in my asking *why* you guys needed a thousand full-custom boxes at a couple million a pop?"

They all sat motionless.

"Thought not," Franklin sighed. "Okay. I'll give it a shot."

Two days later, Franklin chaired the meeting. "You guys," he began with feline satisfaction, "totally deserve the Charles Babbage 'Lemme Try Just One More Thing' Award for thoroughness in computer system design. Congratulations." No one reacted.

He waved up a projection. "This is a map of the direct-link nodes your box could get at. I set up a simulation of this on Esmeralda, plugged in your box and let 'er rip. The first thing I found was that your fancy box does *not* call at random. It looks for primary nodes and it knows who they are: it almost certainly managed to contact three that first time, before you pulled the plug.

"Those three locations, my friends, experienced a total of seven router failures in the hours after your box touched them. Really had the wizards scratching their heads. It's okay now, but could've been beaucoup trouble."

Ferrell interrupted. "Are you implying that we were transmitting some kind of virus?"

"Cooler than that, man," purred Franklin. "You sent three transmissions." He waved and the projection changed. "Each transmission block is the same, except for addressing. Inside each block are four messages. Each message is the same, except for protocol.

"That fancy schmancy custom interface you ordered can speak *in* anything *on* anything. You name it: three-tone on POTS, NTSC on STP; hell, give it hands and it wouldn't surprise me if it did APS Telex on bongo drums. Amazing.

"Anyway, your little box wasn't bright enough to tell what its physical connection was, but it *was* smart enough to look for a common language on connect. It'd try something, wait for an ack, and if it didn't get one it'd try something else. In every case it failed on the first three tries and got through on the fourth. What it said is what freaked the routers."

Ferrell took this with aplomb. "Well, good; that's good, Colonel. Sounds like just a little bug we can get fixed easily. Well done. I guess that solves it."

"Nope," said Franklin. "The operating system's doing this at boot so it's got to be some really important function. If this thing were an animal, you'd have to say it *needs* to do this to survive, just as much as breathing. This ain't no bug; it's a fundamental design feature. You've got to ask why."

Ferrell stared.

Franklin smiled. "Let me give you the sound-bite version. I wasn't getting anywhere jamming bits, so I finally tried pumping it through audio and just *listened* to it." He waved at the diagram: "This third message was the key. Listened to it again and again. Farm, as we say, out. Man."

Ferrell glared.

Franklin's grin broadened. "Listen for yourself. This is number three as sent." They were all familiar with the sound of a fax or a modem on a telephone line. This sound was decidedly different, almost musical:

"*Low*m*rom*dig*ment*ner*etel*pou; *Low*m*rom*dig*ment*ner*etel*pou."

"Now a little slower," Franklin baited.

"*Low*im*from*digo*mentannah*eartel* pou."

"Still don't hear it, huh? Okay—still slower." Finally an emotionless nasal male tenor said, rapidly but clearly, "Hello, I'm from the government and I'm here to help you."■

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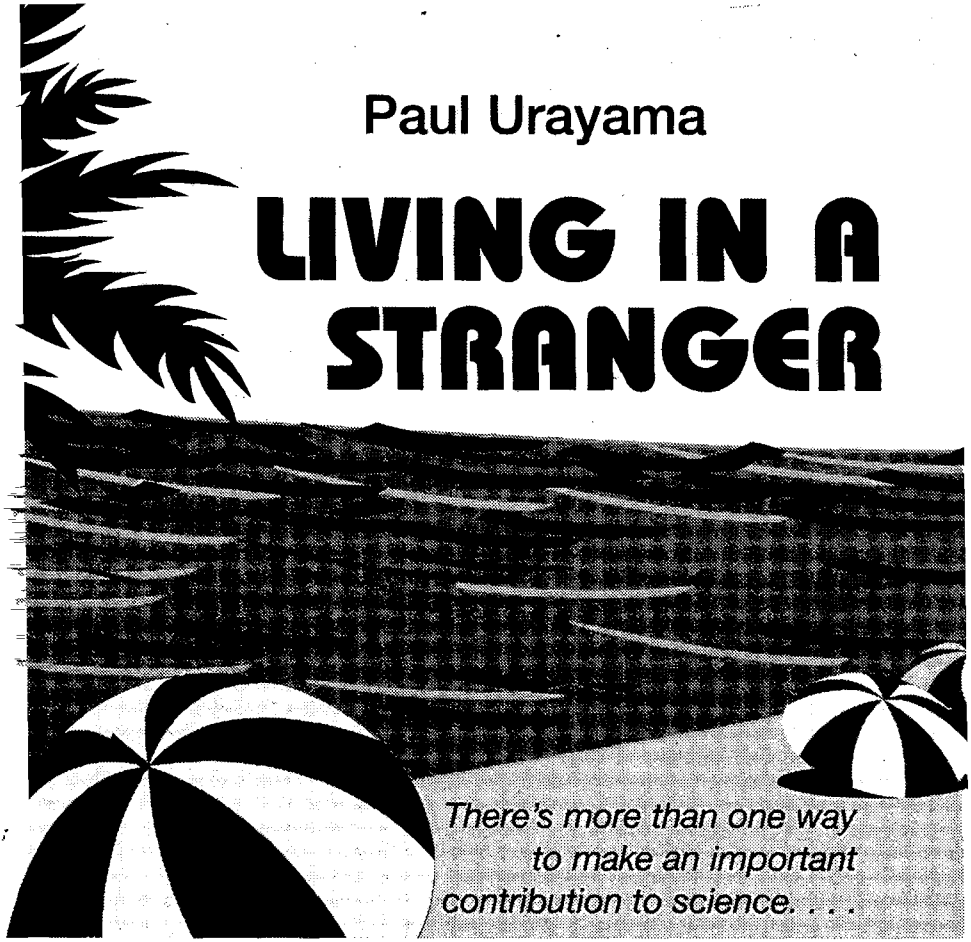
Paul Urayama

LIVING IN A STRANGER



There's more than one way to make an important contribution to science. . . .

PART I

The room was comfortable, though nothing was familiar. Scared, he tried the door. Locked.

Tim searched the dresser and desk, hoping it would yield some information. The desk had a drawing pad, pencils, and charcoals. The dresser had jeans and casual shirts—the type he usually wore.

More desperate, he threw clothes out, looking for something, anything useful. He found a toothbrush and razor. The razor might be useful as a weapon, but against what?

This *must* be a gag.

"Hello!" He banged and yelled louder. "Anyone there? Let me out!"

The door lock rattled. A handsome woman in lab coat entered, closing the door before he could look into the hallway.

"My name is Dr. Patricia Marks. Do you know who you are?"

An odd question, but he played along. "Last time I checked, my name was Timothy Wright."

"Good. I'm glad you remember. You must be confused about what's happening."

Her photo ID badge looked authentic. The La Jolla Behavioral Institute, it read. With a coy smile Tim responded, "And I'm sure you will explain it to me."

"I'll try, Mr. Wright, but it will be a shock."

"Please, Dr. Marks. 'Tim' is fine."

"Well then Tim, call me 'Patricia.' Your last memory is of being at a friend's party, correct?"

He nodded, holding in a chuckle. Still wearing pajamas, he sat on the bed. His stomach growled.

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"Tim, that was nearly four years ago. On your way home, a gang attacked you while you were stopped at a highway exit. It was quite serious. You suffered brain damage—a form of anterograde amnesia."

Tim waited for more, but she just stared. The joke wore thin, so he got up to leave.

"Thank you Patricia. Tell Eric or Peter or whoever that this wasn't their best."

Tim expected a friend's house, but he exited into a white tiled hallway. Patients sat in wheelchairs and doctors stood talking or reading charts.

Confused and unsure of where to go, he returned to Patricia, who wrote something in her notebook. He plopped on the bed, unable to explain his situation.

"I'm sorry we have to present it so bluntly."

"I remember last night. What's happening?"

"Hungry? I'll have an orderly bring some breakfast. I see you've found your clothes," she said, making note of the mess. "I'll be back in about an hour."

Tim nodded blankly. There was nothing to do but obey. He tried desperately to discount what she said, replaying the party in his head. There was nothing unusual, other than it being a little boring.

As he shaved, he noticed a scar above his left brow, running to his hairline. He traced it with his finger, unable to imagine the pain.

"A bunch of bullshit," he muttered, combing hair over the scar.

He ate, but it felt artificial—preprogrammed.

Patricia returned, and led him out of the in-patient area, to a wing with offices and laboratories. Walls were white, crisp, and geometric. They passed reading rooms and lighted atriums, where paintings and busts of famous faculty sat in fond remembrance.

He had no recollection of ever being here, but his feet moved instinctively, like being controlled remotely.

By now, he knew this could be no joke. If that were true, then the consequences were . . .

"Damn it! What's going on? Where are you taking me?"

"Tim!"

People down the hall stuck their heads out.

He ignored them and ran ahead, turning corners at random. He stopped and read the sign on the door: *Dr. Patricia Marks, Associate Researcher, The La Jolla Behavioral Institute*. Her office. He read other door placards, but they all differed. Dumbfounded, he waited until Patricia caught up.

Her office was humble but had a marvelous cliff-top view of the ocean. He immediately stepped to the window and looked out onto the shore, counting the rhythmic waves, familiar and predictable.

"Tim," a voice called from behind.

He turned, expecting a scruffy fourteen-year-old, but saw an attractive young woman dressed in a smart business skirt. Her dusty blonde hair was smooth and shoulder-length. She couldn't be more than—eighteen? What a metamorphosis from the little sister who hung around boys, collecting bugs and bottle caps, and who always tried to wrestle him to the ground!

Jill ran up and hugged him.

"Did you know the judge wouldn't let me visit you since the hearings began? I missed you. You look great." He knew she lied; she bit her tongue. She knocked him on the shoulder in a little sister sort of way. "Well since you ask," she said sarcastically, "I'm fine. My foster parents are cool. They treat me well. School is okay too, and I got into UC San Diego, so I'll be close by."

He felt naked; she assumed he knew things. He was glad—relieved—to see her, but it seemed he saw her yesterday.

"Foster parents?"

"I keep forgetting. I'm sorry. After your accident I stayed with the Richardsons.

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You remember, Mom and Dad's old friends."

He remembered. The vividness of the memories surprised him—his parents' death, quitting college to support Jill, his friends, the party, then today. There was no gap.

Patricia motioned them toward a ragged, homely sofa. They sat, but Jill still held his hand.

Patricia was silent for a moment, then began carefully. "You have amnesia. The trite scenario is forgetting your identity after getting a bump on the head. Actually, that's quite rare. Usually, it's manifest as the inability to remember before a certain point in time, or . . ."

"*After* a certain point. That's what I have, isn't it? That's why I'm convinced the party is yesterday. I can't remember anything after that day."

"Yes. You have anterograde amnesia. The other case is called retrograde amnesia."

Tim brightened, finally making sense of his situation.

But wait, today was after the party. So was this morning, as he lay confused in bed. He asked Patricia whether they corrected his amnesia so he could remember from now forward, to which she became solemn, as if she regretted disclosing the remaining news.

"I should elaborate. Yours is a sleep induced anterograde amnesia."

Tim pressed his lips. "You mean when I sleep I forget?"

"Basically. During the day, a person amasses a lot of information. Most is short-term memory, lasting for a few minutes."

Tim looked away with an ominous feeling. He let Patricia continue.

"We know a region of the brain called the hippocampus is involved in forming long term memories, but we have no idea how your injuries link it to sleep. We can't even be sure the region affected is the hippocampus. It seems unlikely since your injuries are superficial. Your case is very counterintuitive."

"What are you saying? My injuries prevent me from saving memories? Can't you cure me?"

"I'm sorry. We don't know how to correct the damage, but you're healthy otherwise. It's just . . . when you sleep, you forget."

When I sleep, I forget? Like footprints on wet sand erased by the persistent waves, that was his mind.

The realization seemed hollow for he could find no evidence within. The party seemed like yesterday, on a continuous, unaltered timeline. But his surroundings—the Institute, the changes in Jill—were undeniable.

Tim let out a strained laugh. He stepped to the window, trying to lose himself in the waves, but their cycle only reminded him of his condition. Every day, he would start over, forgetting previous day's events, forever in limbo, forever believing he was returning from a friend's party.

He struck the glass, which left a pleasant sting in his knuckles.

"That's enough," Jill said. "You're upsetting him. We should talk about what we came here for."

Jill's urgency surprised him. There was another reason for this gathering.

"Tim, do you have any questions?" Patricia asked.

"No," he said stoically.

He did have questions, but they all seemed too grand for her to answer. What had he been doing these four years? What will he do now?

His mind swam in a haze. Things were moving too fast, and, from their expressions, he sensed they would move even faster.

Patricia opened a folder and removed a document.

"Listen to this carefully," Jill said.

With due formality, Patricia read.

Jill was now eighteen and able to take guardianship of Tim, but the Institute wanted him. They argued that he could not care for himself, and that with his unique condition, he was too valuable

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to science. There was much to be learned about memory, sleep, and how the brain functioned. His extraordinary situation justified giving the Institute, rather than Jill, guardianship of him.

Jill was cautious when the Institute approached her. Being his only relative, she planned to care for him. However, if the Institute could make guarantees about his living conditions and treatment, she would consent.

The judge considered both arguments. He agreed that Tim needed supervision. However, he found Tim to be an alert, aware, and sensible twenty-four-year old, fit to choose his own custodian.

So on this day, Tim would be given full disclosure of his condition. He would spend time with Patricia and Jill, to talk and come to terms with his condition. He would decide his future—Jill or the Institute. His decision would be videotaped at day's end as a reminder to himself.

And so the order read. Flawed or not, it was being carried out.

"Wait," Tim said, slamming the sofa. "I don't agree to this. Why would I want to stay at the Institute? I'd be a guinea pig. Jill, I'm going with you."

"Before you decide, Tim, weigh the consequences. Hear us out, that's all we ask."

"Please, for me," Jill said. He turned, shocked that she would defend this. "We have a lot to talk about, but you need to spend time with Patricia. I'll be back this afternoon."

"Fine."

She hugged him as she left, but he ignored her. She walked out, noticeably hurt. He should apologize, but later. He had a lot to absorb.

Patricia started by showing him laboratories with chemicals and centrifuges; the veterinary wing with shelves of scurrying mice; seminar rooms; and lecture halls. The coffinlike MRI setup was particularly impressive.

As they walked, people greeted them. Some asked Patricia to look over reports or memos. Tim stood to the side unassumingly. A few smiled at him, and he wondered if he met them before. He returned a generic, "How do you do?"

His steps felt unguided and easy, unlike the surreal trip to her office this morning.

"Memory is strange, isn't it?" Patricia said. "You can learn things without realizing it. You've been living at the Institute for the past half year and visited my office many times. You learned how to walk there. Learning tasks is called skill memory. The more familiar type is called episodic memory. That's the recall of episodes or events."

Tim sighed, intrigued.

"This is one reason your case is so important. Why can you form new skill memories, but not episodic memories?"

"It's strange not remembering learning something, like those shows where a hypnotist plants a suggestion."

"I've been to one of those. Imagine a portly grandfather dancing like Madonna whenever he hears 'Like a Virgin.'" Their laughter echoed through the hall, softening the austerity of the situation. Patricia's face took on a gentle kindness, crinkled around the eyes, reminding him of his mother.

"Patricia, why do you want to do this?"

"This?"

"Keep me here. Why do you want to study me?"

"There are a lot of open questions in neurobiology. Your case . . ."

"No. That's not what I mean. Why do *you* want to study me?"

She thought for a moment. "Well, you present a challenge. The prospect of unraveling your curious loss excites me. As a scientist, I feel drawn, compelled, to accept that challenge."

He appreciated her candor and could relate, having been a chemistry major in college and intending a research career. But still, he would be surrounded by people who viewed him as a puzzle, an interesting subject, a source for research.

From the glass wall of the hallway, he

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saw people in the courtyard, talking and drinking coffee. A baby palm provided shade. It would have to be transplanted eventually, but it served its purpose for now.

Would he ever outgrow the Institute and cease being useful?

"We are willing to accept the responsibility. This is a major commitment, we realize that. We would provide for you indefinitely."

"Provide for me, but would anyone care?"

"We wouldn't deny Jill her visitation rights. You would still see her."

"That's not the point. This place could never replace family. Give me something to make me want to stay. I'm not trying to be difficult. I'm listening. But so far, I don't see how the Institute is any better."

"Tim, I want to show you something."

They walked back toward her office. He waited in a conference room with plush tan carpeting and soft reclining seats. Bored, he pressed the computer monitor, activating a video projector. He touched the monitor again, and the projector traced out his marks.

"Cool." He drew a caricature of Patricia as a mad scientist, snickering as she mixed chemicals. The door opened. "Oh, shit!" He scribbled over the monitor, not sure how to turn it off.

"Playing with the toys?"

He nodded, embarrassed.

"I want to show you this."

It was a portfolio. Inside were charcoals, mostly of beach and ocean scenes. They struck him as familiar, a distinctly different sensation than how he had been feeling all morning.

Tim drew as a hobby and he knew these were his. He eyed Patricia, with her calculating look, as if studying his reactions.

"Beautiful, aren't they?" she commented.

"These are mine."

"You recognize them?"

"They are like children. You feel them as yours somehow. But I don't remember drawing them."

At that, a sense of regret. He felt no satisfaction in viewing his work. Without memory of the process, the results became hollow.

"Why are you showing me this?" he asked, shutting the portfolio.

"You said you wanted a reason to stay."

"Drawings?"

"Almost every day, you would go to the beach and draw. You spent hours there. Why?"

"I don't know. I can't remember."

"Think. Why would you spend hours at the beach? Doesn't it seem like a waste of time?"

He perused the drawings again. They were of similar scenes, but explored the ocean's many personalities. One of violence, one of serenity, another of naivete. They beckoned to him; each had a story to tell.

Stories? Each was a voice from the past.

"I hoped the drawings would be my memory."

"That's what you said when I asked you on other days. Do the drawings help?"

The drawings were a memory, yes, but they seemed like someone else's. He could not relate. The intimacy was gone.

Patricia showed him a journal he sometimes kept. He read through several pages. Confusion, anger, and fear—similar to what he felt this morning, but again, the words were unsatisfying.

He knew the drawings and words were his, but they were empty—hearsay. He couldn't say with perfect confidence, "Yes, I did that," because the memories were not internal.

What was the purpose of it all? Every day, he would be wiped clean. He could not plan, nor hope, nor dream of the future. There was no continuity. He would die if he slept.

"Damn it." He flung the drawings off the table. "I don't see how this makes me want to stay."

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Then it hit him. Perhaps, he'd been holding it down, but the enormity of it all hit him. He cried, frustrated and tired.

"No purpose," he whispered. He cried on Patricia's shoulder.

"Remember to stay within the Institute," Patricia had said.

She wanted to talk and help sort through his feelings, but he needed to be alone. He was embarrassed for his outburst.

Tim inhaled, but the ocean air was drab and uninspiring. His pad had only a generic sketch of the horizon and diving seabirds. Instead, he turned and drew the Institute, atop a cliff with exaggerated dimensions, ominous and foreboding. He couldn't spend his life here, not when he would be surrounded by damn scientists.

Why did Patricia show him the drawings? She must have known he would react this way. What was the purpose? There was none, he gathered. Meaningless. The word echoed with the waves.

Suddenly it darkened.

Tim turned right to see a faceless shadow. Then blinding brilliance as it moved to expose the sun. Tim shaded his eyes.

"Sorry," giggled the shadow. Jill. She wore shorts and a t-shirt. Her hair was in a ponytail. This was the Jill he remembered. Casual and fun-loving.

She sat next to him with a basket. "Lunch," she said, her tone part declarative, part inquisitive.

She placed a tuna sandwich before him. He stared at it.

"Tim, don't do this."

"You left me."

"I know. I'm sorry."

Tim huffed, unable to hold a grudge. She was family.

His drawing caught Jill's eye, who picked it up before he could stop her. Her face looked pained as she realized its contents. She held back a tear.

Then how could she even consider letting the Institute take him? Ask her, damn it. Ask her. Find out.

They ate in silence. Tension reduced their meeting to awkward smiles and accidental glances. Time was running out. He already felt tired. Too soon. The day was only half over. Too soon to die.

Suddenly, Jill started talking, but not to Tim. She rambled, half dazed.

"The Richardsons are great. They're so kind." She looked at Tim with a seriousness that made him shiver.

"I remember. They helped a lot after Mom and Dad died," Tim said, trying to shake her stare.

"Did you know they took care of you after your accident?"

"Really?"

"It's hard to believe. For over three years, Tim. Every day was a struggle. Every day we would explain to you what happened, not really sure how you'd react. I'd be so scared to tell you. I never did it alone.

"Oh, sometimes you took it well. A few times you got angry. No, frustrated, I guess. Once you hit Mrs. Richardson because she wouldn't let you go out."

"I'm sorry. I don't remem—"

"We didn't blame you. We never did. But it was hell for us."

Jill waded in the ocean. Tim followed, needing to hear the rest.

"I love you," she said. "I know you sacrificed a lot. College and all, I mean. I honestly want to take care of you, but I cried when Patricia came to me. The reason I cried makes me feel so guilty. I'm evil."

Jill stared at the horizon.

"I cried because I was so . . . relieved." Her voice trailed off, but he heard.

The confession struck hard, making him dizzy.

Jill must have sensed something, for she knelt in the water. She winced as the waves splashed, wetting her shirt and coating her face in salty mist.

He cursed himself for not realizing this sooner. She was sweet. She was his little sister. How could he burden her? How could he burden the Richardsons?

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He knelt next to her, as if to pray. "Help me want to stay."

"Patricia told me what happened with the drawings. I think you have good reason to stay. You're important, Tim. More than you realize. You see, Patricia told me . . ."

Her tone was confident and reassuring. He tried desperately to trust her, for being a burden was more disturbing than spending his life amongst cerebral strangers. He forced himself to absorb her optimism, and that made the decision simple.

PART II

I meditate on the static filled monitor.

I just saw a ghost, and the ghost was me.

The party was yesterday. I remember it clearly. Dr. Marks claims that was fifteen years ago. A sleep-induced anterograde amnesia—Marks' Affliction—prevents me from forming new memories.

My aged appearance and my surroundings are undeniable. Damn it. And now the video of me, the me I remember, asking that I cooperate with Patricia. "Patricia" he called her, as if they were old friends. That bitch.

I laugh. I'm referring to myself in the third person.

This started when I awoke in a stranger. I hardly recognized myself in the mirror.

After breakfast, the news sank in. Fifteen years were gone. Poof. Dr. Marks and I talked awhile. She was polite. I felt sorry for her, having to go through this with me every day, but she said I usually talk to her assistants.

When I considered my predicament, I got angry. I blamed Dr. Marks. Illogical, I know. One doesn't think straight when everything feels hopeless, like having a terminal illness.

What cruel being would leave a person with such a frustrating loss? If I had an amnesia that would let me learn nothing new, then that would be kinder. I would soon forget that I can't remember. But to let the knowledge linger, only to be lost by sleep? Hell resided in the waiting and the dwelling.

What purpose is there to life if all I can do is dwell?

I thought of Jill. She is in her thirties now. Dr. Jill Cunningham, doctorate in molecular neurobiology. Little sis, who would hang around me just to be one of the guys, was married. Did I go to her wedding? Does she ever visit? I'm told I see her every Monday and Thursday. Today is Friday.

Then Dr. Marks asked me to be a guinea pig; she wanted me to take tests. Fucking tests. Sure, exploit my condition. Collect your data and publish your papers, all to build your reputations and careers. I know about the scientists' pecking order. Where do you stand amongst your colleagues?

The lack of compassion infuriated me. I refused to cooperate. I wanted to be alone, to exercise my right to sulk.

Dr. Marks explained the situation vaguely. I had been committed to the Institute. Jill and I agreed fifteen years ago. Dr. Marks showed me the video, recorded by me, explaining why he had agreed to stay.

So I sit here now, staring at static. In the video, he seemed happy and at peace. He must have felt the same as me, faced with this fragile existence. He is me, after all. And yet he decided to stay. What changed his mind?

It was Jill and the need for purpose, he explained. He didn't want to be a burden to her. I can understand that, but the latter is harder to swallow. I know he means I should give myself to science, but how can studying my loss be anything more than academic?

I could protest. I could survive without being a burden to Jill by keeping a journal or making a note to myself every night, telling me where I left off. No, it's a bad idea. It would be like the video. Me, but not me. If I had something like that now, I wouldn't read it. The feelings and the instructions would seem foreign

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and external, like . . . being *ordered* to feel and act a certain way. There is no point in protesting. I would be fighting fifteen years of precedence. So I comply. I suppose trust and faith in myself, in Destiny—okay, in God—are all I have. What a time to become spiritual, but it's the only way to survive.

PART III

You close your eyes.

"Yes, I remember," you announce, trying to hold your voice steady. "I remember the treatment and the exam. In fact, I remember the whole week, even what I had for breakfast. Did you always feed me that?"

You smile, but wheeze a dry cough.

"Be careful, old man," Jill says.

"Old? I feel twenty. Now help me up."

You hold out a wrinkled hand, which she takes gingerly. Your legs are weak, but sturdy enough.

"Sure you're okay, Mr. Wright?" a young Asian woman says.

"Meg, quit it with the mister stuff. 'Tim'—remember?"

But the formal title probably seems more natural to her. She is only eighteen. You thank Dr. Megumi Ito and begin your slow trek down the hall, stepping carefully behind your walker. Jill keeps you company.

"Who'da thunk they can be so young."

"Strange, but I'm getting used to it. You know it's your fault," Jill says.

This past week was like waking from a coma. Events seemed continuous. You were at a friend's party one day, then at the Institute the next. The kicker was that fifty- seven years had passed.

It took a while to explain the situation. A massive headache slowed your ability to communicate. When it passed, things made sense. You didn't recognize Jill, whom you mistook for your mother. That was a frightfully harrowing experience, since you remembered her death.

The fuss made over you was amazing, even annoying, almost like you were a . . . museum piece? The bronze bust of you was a bit of a surprise, next to the bust of a woman named Patricia Marks. Nobel Prize in Medicine, it read under hers. She died five years ago. You would have liked to have met her. Pictures hung on the walls showed you two together through the years.

"Imagine that."

"Imagine what?" Jill asks.

"I was just thinking."

"About?"

You start to answer, but someone taps you from behind. "Shake a leg, Mr. Wright," Meg teases, as she passes you two in the hallway.

You sigh.

"She's quite fond of you, you know."

"But in a grandfatherly sort of way." You laugh, making it a joke to hide the disappointment.

Jill guides you to a courtyard, where a tall palm grows in the center. Your legs are too weak to ease you onto the bench, so you feel the brunt of the icy metal.

"So why is Meg's youth my fault?"

"I was being sarcastic, but you did play a role in it." Jill takes a seat next to you and points to the shore. "It started down there back when I was, my gosh, eighteen— Meg's age! That's when you agreed to let Patricia study you. But I explained this already."

"I can't believe you agreed to it."

"I had to." A pause. "Upset?"

"No. I understand it was the right decision. You've made a wonderful life for yourself. You've accomplished a lot."

"I have, I think. I studied the brain mainly to help you," Jill explains apologetically. "But it became more."

"It's related to all the fuss people make over me?"

"Partially. You're a legend. You helped unlock the mind. Oh Tim, the key was sleep. Sleep! Can you imagine that? It seems so obvious now."

The thrill in her voice resonates through your confused bones.

"Sleep is not passive," she says, with

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perky animation reminiscent of the little sister you remember. "The body may be inactive, but the mind is not. It ignites upon sleep, freed from the barrage of external stimuli, from the mundane control of voluntary muscles, from the distractions of consciousness. Dreams are only the superficial signs of sleep's activities. Let loose on the internal mindscape, the brain organizes, evaluates, experiments, and explores the infinite possibilities based on the template of reality. The brain flexes its associative muscles—what memory goes where, conditioning, habits, likes and dislikes. Nothing held back. Inspiration and creativity all heightened, wild and free, but lost when awake because consciousness must conform to reality.

"Tim, once we realized the cause of Marks' Affliction, other things fell into place. Of course we had to wait for other technologies—better ways of probing the living brain—but understanding you made it all click. Like when Newton came up with his Law of Universal Gravitation, suddenly the moon's motion became no different than a falling apple's."

"Wait, Jill. Too fast! I don't understand. What did you discover?"

"We've learned to prop open the doorway between sleep and wake. The procedure requires grafting neural matter into the hippocampal region and must be done during adolescence, but it facilitates learning. It sustains the activity the brain has during sleep. They say Einstein used only one third of his brain. We've tapped into part of the other two thirds!"

A sudden chest pain makes you grimace. Jill braces you, reading the medicomp strapped to your side.

"My fault," she says. "Too much at once."

She wheelchairs you to your room. You lie down, mind full of questions. How far has this gone? Any side effects? Who can have the procedure? What is school like? Hell, what is society like?

She sees your anxiousness, but insists you rest.

You try.

This past week, you've had an irrational dread of sleep, but now you feel unexpectedly peaceful, and, though it is still bright outside, you doze off into an unconditional sleep.

Water drips, smearing the ink. You wipe the page, then your face, tasting the salt.

When you asked Jill about the missing half century, she hesitated, but she brought your journals and drawings.

Entries were separated by about a week, usually written at the request of Dr. Marks. The one for the day he decided to stay is especially poignant.

You shift uncomfortably.

In the beginning, the scenarios were similar: confusion about waking in an unfamiliar place, anger toward his condition, a profound sense of helplessness, fear of the future and of sleep, and occasionally, peace.

Pages were annotated, presumably by Dr. Marks tracking his mental state.

As decades passed, there was a gradual shift toward acceptance. Dr. Marks speculated that non-episodic learning (a skill memory for the Institute environment) and changes in appearance with aging facilitated acceptance of his situation.

In all the entries, there was a common theme—pain. Pain in not being able to know the future. Pain from knowing that the person he was would be erased only to be recycled.

You feel for him. "I was him," you say, mostly out of need to hear the words. You look, making sure no one is around. You repeat the sentence—"I was him. I was him. I am him," hoping it will sound less hollow, but the sensation is the same. At best, it's like mourning the suffering of a brother you never met. You place the journals down, suddenly feeling as if reading another's diary.

You examine your hands, covered in age spots. You are old. The journals describe your missing half century. No. His half century.

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Then there are the drawings, echoing from the past in a haunting chorus. Most are of the ocean, of the Institute, and of the surrounding grounds. One is of a beautiful woman, chin on hand, staring pensively into the night sky. Did he know her, or was she his fantasy?

Wondrous discoveries stemmed from the study of Marks' Affliction. Take Megumi, only eighteen and already a respected neurobiologist. She has a promising future. There are others like her, made brilliant by a tweak of the brain. Humanity has such potential and you are hailed as the key. A respected artifact. The grand master of guinea pigs.

You don't want credit. He should receive the accolades, every one of him.

My gosh, he didn't live a fifty-seven year hell! There was a new person for each day.

And which one are you?

"I am Timothy Wright."

No, I am him. You hear thousands of voices emanating from the reading room walls.

"Who are you?" You hide your ears, but the voices are unrelenting. "Where is this coming from?"

I am Timothy Wright.

"No, I remember being him."

So do I. Am I you?

A sharp pain. "No. I don't remember you!" The pain repeats, with a banging sound of wood in synch with the thumping.

"Stop! You're hurting me." Your head throbs and your vision is filled with a Brownian haze of lights. "What are you doing?"

Let me out, please.

A sweet voice surrounds you. "Meg, I need you in the reading room! Tim's neurograft didn't hold again."

You look up from the desk. Your head jerks, but you manage enough control. Her glassy eyes are focused on your forehead. She caresses your wet cheek, and you feel the chill of her touch. She pulls away, hands red.

Her lips form words, but your comprehension is delayed. You filter the pain, struggling to understand. "I'm so sorry. I was sure it would work this time. Meg was right. I'm afraid you're too old." She frantically applies pressure to your forehead. "You never hurt yourself this much before."

You look around but don't recognize the room. "Mom, is that you? I thought you would never come back." She cradles you, rocking, calming. "Why did you wait up? The party wasn't that late. Where's Jill? I had this dream. You wanna hear?" ■

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Grey Rollins

ASHES TO ASHES

When parent and child grow apart, new kinds of problems arise—even when parent and child are worlds.

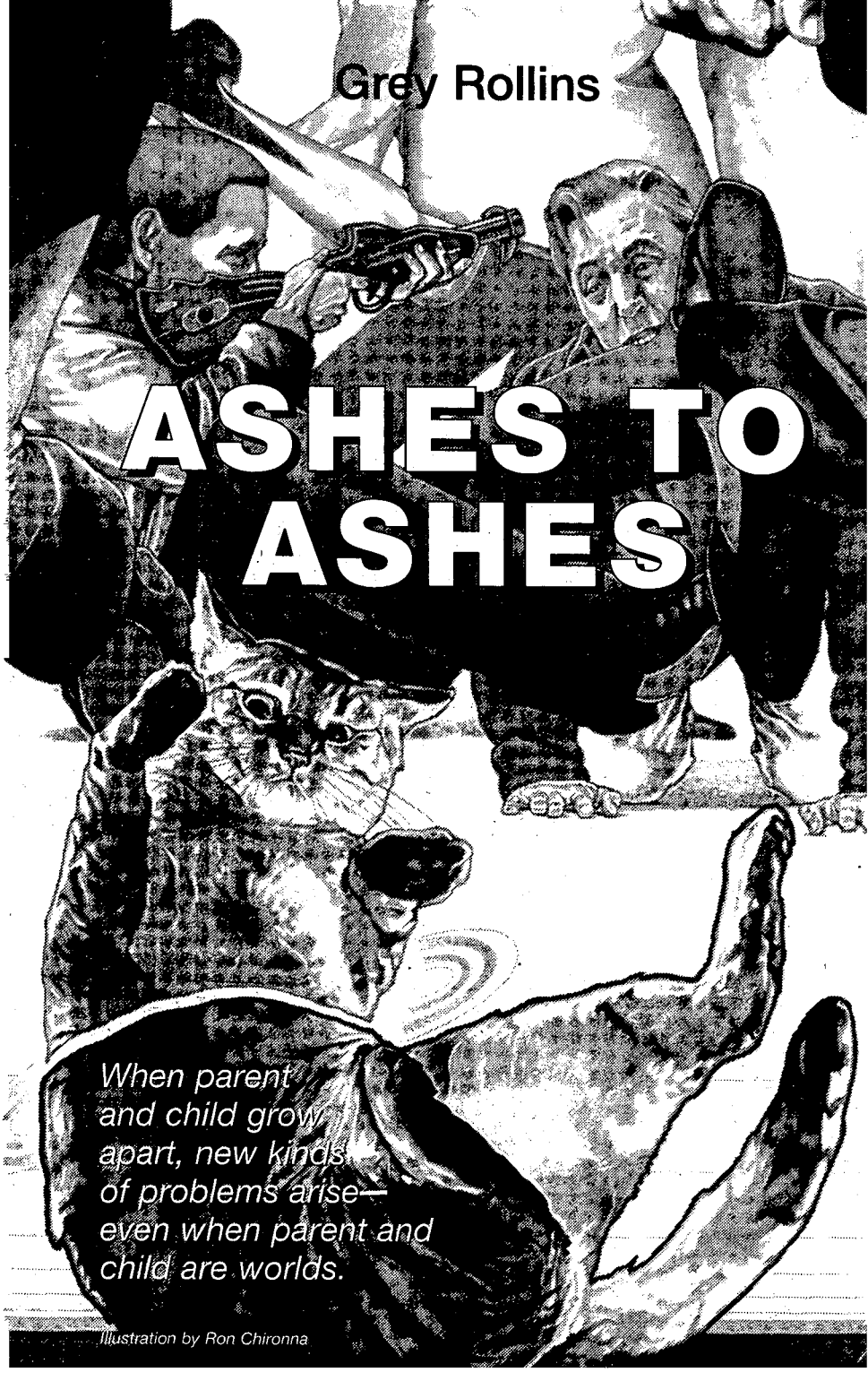

Illustration by Ron Chironna

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Religion thrives on troubles. And the people of Earth had nothing if not troubles.

After years of slow attrition, attendance at churches was rising once more. Their will broken by the ongoing Second Global Depression and yearning for solace, people sat in rows and listened to sermons telling them to humble themselves to the will of God—that the current problems were either a test of their faith, or punishment for past sins and excesses, depending on the creed of the church. More and more, people gave up their dreams of prosperity and settled in with what they had—determined to be content. They told all who would listen how happy they were to have their health and family, all the while shivering and rubbing their hands to stay warm.

Their dreams ground to dust and being all too human, the people of Earth created a corrosive concoction of equal parts desire for a scapegoat and sour grapes. By degrees, being poor went from a thing of scorn, to being acceptable, and from there to being downright virtuous. Those who were down at the heels were regarded as having renounced the materialistic excesses of the Twentieth Century for the more spiritually enlightened Twenty-first. Some took vows of poverty, thereby formalizing their economic status. The converse, being prosperous, went from being envied to admired, admired to tolerable, and from tolerable to almost sinful.

Those who were getting along better than their neighbors were regarded as being, if not in league with the Devil, then at least on the road to ruin. The more pious members of society became increasingly vocal in their condemnation of those with wealth. In Memphis, a prosperous factory owner attempting to enter his driveway on the way home from work was dragged from his Mercedes and beaten by zealots. They were led by a man who shouted, "It will be easier for a camel to pass through the eye of a needle than for you to get into Heaven!" as he tossed burning rags into the man's car, setting it aflame.

In Birmingham, sixteen members of the local Baptist church used sledgehammers to pound the interior of a corner store to rubble after the owner told them that he didn't want them setting up a table of religious literature in front of his store without his permission. A dentist in Seattle was killed for telling Jehovah's Witnesses to get off his property. Throughout the country, members of religious groups were becoming more belligerent with every passing day.

The pendulum had swung and the United States, once the strongest of nations, was being gnawed apart from within . . . by people convinced they were saving it.

Wyatt Mitchell turned into the parking lot of the hotel, pulled up to the front doors, and turned off the car, but hesitated before getting out.

"Angela?" he whispered.

"Surely, you didn't think I'd jumped ship, did you?" responded the computer on the passenger seat beside him.

Mitchell smiled faintly. "Tell me again how easy this is going to be."

"Your choice—either you were in a wreck, or you got in a fight with your brother-in-law. Just make sure not to joke too much. Act serious. Act tired."

"I'm not good at lying."

"I know, but you can't tell them the truth."

He sighed. "Damn. Tell you what . . . why don't you go in there for me?"

"No legs," she reminded him. "Computers don't walk very well. I can't even project a hologram from this little thing the way I could at home, so we're back to you."

"Damn," he repeated. "All right. Here goes."

He pushed open the door of the car and entered the lobby, limping slightly.

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The reservation desk was on the left. The woman in the white blouse with the name tag looked up . . . and stared at the ghastly apparition coming towards her.

Mitchell smiled—tried to, anyway. "Hi. I'd like to get a room for the night."

"A . . . room," she repeated. "Um, yes . . ." Her eyes travelled over his face, stopping here and there. "King? Queen?"

"A queen will be fine." He made a snap decision and gestured at his face. "I won a bet with my brother-in-law. He wasn't at all happy about it."

Her brow furrowed. "I'll say. Can you see out of that eye?"

Mitchell nodded. "Looks pretty ugly, doesn't it? I don't think I'll make any more bets for a while."

"Your wife ought to say something to that brother of hers," she remarked conversationally as she fiddled at the computer terminal. "People shouldn't treat kinfolk that way, whether they're blood relations or in-laws." She looked up. "Is your wife with you? I mean, will this be a double occupancy?"

Uh oh. No prepared answer for that one. "Um, no. She's still at home. I've got to make a sales call tomorrow morning, but once I'm done with that, I'm going home and take it easy for a few days. It's embarrassing going places looking like this."

"Yessir, I can understand that. I fell and hit my eye on the side of the bathtub once. It didn't look as bad as yours, but it was awful hard to explain." She pointed at the small glass rectangle on the counter. "Press your thumb there, sir." After he had done so, she said, "You'll be in room 130. It's just on the other side of the restaurant. Press that same thumb on the lock plate to open the door. We offer a complimentary breakfast roll and non-denominational prayers at seven o'clock in the Savon Room. It's through the door right behind you. Feel free to stop in tomorrow morning and get your day off to a good start."

Mitchell thanked her and went back out to his car. As soon as he slumped into his seat, Angela asked, "Well? How did it go?"

He grimaced as he told the car to start. "As well as could be expected, I guess. At least she didn't scream when she saw me."

"*That* would have done wonders for your tender male ego, I'm sure."

Once they were in their room, Mitchell placed the computer on a small table near the room's terminal. "I think this has been the longest day of my life. Everything hurts except my hair, and I think I feel a hairache coming on."

"You're alive . . . and that's a great deal more than you expected twenty hours ago," Angela pointed out. "For a while there, I thought I was going to be a widow."

"We're not married," he breathed painfully as he unbuttoned his shirt, wincing as he slid it down off his shoulders.

"Just give me a chance, buster. I'm going to snatch a little DNA and grow me a body. Then I'm going to hop into that body and come after you. You don't stand a chance."

"Angie, all I know is how to code a computer. I don't know a thing about DNA, and even less about how to copy a computer program into a human mind. Science is wonderful stuff, but the last I heard they hadn't managed that trick yet."

"I'm determined," Angela insisted. "I'll handle it myself."

Mitchell chuckled in spite of his pain. "If anyone can, you can, babe."

"Count on it. But first we need to get you put back together. My whole scheme falls apart if you get yourself folded, spindled, and mutilated. Step one was to get out of town. We've accomplished that. Step two will be to arrive somewhere, and I don't mean this room. So what's the plan? Have you decided where we're going?"

There was a large mirror over the sink. Mitchell was standing before it with his right arm raised, examining a large purpling bruise on his ribs. "This hurts like hell. I hope nothing's broken."

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"Is there any way to get me out of this portable? I need some eyes to see with. This poor little thing hasn't got any peepers."

"I'm afraid not, babe. There's only the terminal here in the room. You'll just have to do the best you can." He winced as he removed a gauze pad from a ragged cut on his left forearm. "Besides . . . if I let you out, I'd have to pay for double occupancy."

"That's the best thing you've said yet."

"What?"

"If you're cracking jokes—even bad ones—you'll live."

"Just keep one thought in mind."

"What's that?"

"You'd better hope I make it, because you aren't in my will."

"Somebody call a lawyer—we need that will updated!"

Mitchell allowed himself a tight smile. "Don't know what would happen if that hit the courts. Can a computer inherit?"

"I don't know if there's any precedent. Should I run a search?"

He turned from the mirror, made queasy by the sight of his own body. "Maybe later. Right now I need to rest."

"Okay. I'll be quiet after I make two requests."

He eased onto the bed, wincing. "I'm listening."

"I asked you earlier, but you didn't answer. Where are we going?"

"Luna, I think. Remind me to call my folks in the morning and let them know."

"Won't it be hard to get into Crisium?"

He shrugged, shoulders flat against the mattress. "They'll probably want us to get on a waiting list or something. I'll plead hardship, maybe claim political asylum. I'm making this up as I go along. What's the second thing?"

"Will you leave me running so that I can watch over you while you sleep?"

"Guardian angel, huh? All right. Permission granted," he said as he pulled the covers up.

A short time later, the computer whispered, "Good-night, Wyatt." But he had already drifted off into pain-ridden sleep and did not hear her.

Wilbert Dinkins was a shy, quiet man who lived alone. There was an older woman who sometimes spoke to him when he did his clothes at the laundromat, but she hadn't been there for six weeks now, and Wilbert didn't think he'd see her again. His janitorial job didn't start until midnight, and he got off at five-thirty, so he didn't have all that much contact with other people. Next to none at all, as a matter of fact.

Just Jesus.

And Hangdog, the cat, but he couldn't talk.

Now, Jesus, he could talk a blue streak. In fact, you could hardly get him to shut up once he got going, sometimes. He went on and on. Talked about this and that, and that and this. And always just out of sight. No matter how fast Wilbert turned his head, Jesus managed to float back out of sight; must be some of that holy magic. Try as he might, Wilbert had never caught a glimpse of him—just wanted to see if he had long wavy hair the way all the pictures showed. Didn't make sense. How could Jesus look like a white man if he'd been born over in the Mid-East? Everybody over there was dark skinned. Made no sense at all. But never having been able to see Jesus for himself, he had nothing to fall back on but the stereotypical image of a man with beseeching eyes and clasped hands.

Wilbert walked up the stairs to his apartment after paying the taxi driver. The open central stairwell was whipped by a wet, raw wind that made him glad to get home. This being mid-December, the gloom of dawn was still hours away, and the street lights reflected off the rain-glazed parking lot below. He unlocked the door and slipped inside sideways so Hangdog wouldn't have a chance to dart between his legs.

No problem there. Hangdog was

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curled on the wide window sill watching the rain through sleepy, half-closed eyes. The cat stood, stretched, and jumped down, then bumped and stropped against his ankles with as much demonstration of affection as a cat will allow itself.

Wilbert bent and picked him up. "Jesus tells me that you've been good today. He says you haven't pooped on my pillow. Let's go see if he's right."

Still carrying the cat, he walked down the short hallway to the bedroom. As advertised, the white pillow cases at the head of the rumpled bed were unsoiled.

"Hey! That's great!" Wilbert said, lifting the cat to eye level. "Jesus says he wants me to give you a can of the good food."

The cat, without understanding a word, was intelligent enough to grasp the tone in Wilbert's voice. He began purring.

While Hangdog was devouring the food Wilbert put out for him, his owner was staring at the apartment's terminal. Not of the best quality, stuff on the screen tended to skew a little towards the right, and, if left on long enough, it began to jitter, but complaints to the landlord had been ignored.

There was a news item about a man who had been forced to leave his home for having created a living computer program. Wilbert didn't understand some of the words they used, but the idea of being out on a night like tonight without a roof over his head made him distinctly uncomfortable. The news report gussied it up, almost as though they wanted it to sound like the man had really done something bad, but to Wilbert it looked as though they were picking on him for no reason.

Wilbert understood persecution. People didn't like janitors who heard Jesus talking to them, even though some of *them* claimed to talk to Jesus, too. Wilbert had never understood why it was okay if Jesus talked to them in church, but not okay if Jesus talked to him in his head.

Wilbert shook his head and went back to watching the news. The man had nowhere to go. Somehow, Wilbert wasn't exactly clear on this, but it seemed that there was a woman with him. They acted as though she was a computer, but the picture they showed looked real enough to him. She was pretty. That meant that this man was not alone—that this beautiful woman with him was out tonight, cold and wet, with no home.

He finished the news, and turned to see Hangdog washing his face, all proper-like. Clean cats were good cats. That's the way Wilbert liked it. Except for Hangdog's one little thing about using his pillow for a litter box, he was a good cat.

Wilbert glanced at the wobbly little table at the end of the couch. On it was his one and only Christmas ornament. A cheap plastic manger scene. A woman, a man, and a baby. There were farm animals looking on.

And Jesus spoke softly from just behind his right ear. "Behold, Wilbert, a miracle."

That confused Wilbert. "Where's a miracle?"

"Behold!" Jesus commanded.

All he could see was a rickety end table and a . . . a . . . "The manger?"

"Yes, Wilbert, the manger."

When he got nervous, he stuttered. "But it's just p-p-plastic!" Even Wilbert knew the difference between plastic and the real thing.

"A man and a woman. They were refused shelter."

"But they're only little p-plastic people!"

"Once they were real people, Wilbert."

This was getting worse. "B-b-but they're so tiny! How c-could they have—"

Jesus was nothing if not patient with Wilbert. "A man and a woman out on a cold night, needing shelter."

Something hovered just outside of

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Wilbert's grasp. "A man . . . a woman . . ." he muttered aloud.

"A man and a woman . . . out on a cold night . . . needing shelter," Jesus repeated.

"B-but it w-w-was a l-long time ago! All over n-now."

"It's happening here, Wilbert . . . now. In your time."

"Who? W-w-where? W-why?" Confusion clouded Wilbert's mind. Jesus wanted him to figure something out, but he couldn't. He just plain couldn't. Didn't Jesus know he'd had trouble in school? And the time when Shelton Burns had taken him out in the woods behind the school and . . . and . . .

"Wilbert, you must go to them."

In the middle of the floor, Wilbert Dinkins sank to his knees, his face in his hands, brought down by the near physical guilt of his inability to understand what Jesus wanted from him. "Who?" he whispered into his palms. "I don't understand."

"Look up, Wilbert. Open your eyes."

Slowly, he dropped his hands. Almost against his will, he opened his eyes. Then he raised his gaze.

His eyes fastened on the terminal. "I . . ."

"A man and a woman needing shelter, Wilbert."

It was as though the very heavens split open, so blinding was the revelation. "They? Th-the guy they chased away?"

"Yes, Wilbert."

"I . . . I . . . but w-w-what do I do? Where do I go?"

And outside the window, the racing clouds parted, revealing a full Moon, low against the horizon.

Still kneeling on the floor, Wilbert Dinkins shuddered, implacable destiny beginning to tug at the frayed corners of his life.

Moving quickly, he pulled every bit of cat food out of the cupboard. Every can, every box of dry food went into a tremendous pile, covering Hangdog's small, cracked saucer where he usually ate, spilling over onto the floor, growing into a fair-sized mound. Next to it went a mixing bowl full of water, the largest open container Wilbert could find.

On his way to the door, Wilbert grabbed his threadbare coat, then paused, seeing Hangdog looking at him with a decidedly strange expression. "I . . . I've got to go. Th-they n-n-need me. L-look, I'll be back. I just don't know w-when, okay? So don't eat all that at one time."

Wilbert made it halfway down the steps before his reason stopped him. Every manger scene he'd ever seen had sheep and things. Animals. Wilbert didn't have any sheep. He'd never even seen a real sheep, only pictures. An animal . . . where could he get an animal?

Three minutes later, Wilbert was flying back down the stairs, clutching a badly confused cat in his arms. His coat pocket bulged. In it was a glass jar. In the glass jar was his only intact picture of his mother, unframed, and all his carefully hoarded money.

As the sun rose that bitterly cold morning, Wilbert Dinkins was waiting for the bus, a cardboard box by his side with crude holes punched in its sides.

When the annunciator chimed, Anne Lister felt a quick flash of annoyance. Other than her son, she hadn't seen anyone in days and was content to leave it that way for the rest of her life. Humanity in general had palled on her and she wanted nothing to do with anyone.

She almost told the computer to refuse entry, but relented. Sighing, she said, "All right, unlock."

And then the man just stood there, as though he was waiting for her to come out, not the other way around. "Anne?"

She had been staring down at her hands, but on hearing her name, she looked up. "Edgar? What are you doing here?"

Edgar Rice shrugged. "I was going to ask you pretty much the same thing."

She frowned. "At home? I don't understand. Where else should I be?"

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He waved a hand to include the corridor where he stood. "Out here. At least occasionally. This is your city, you know . . . to the extent that anyone can claim a city, this one's yours."

"So?" She shrugged.

"I've been worried about you, Anne. You've holed up in here as though you're under siege. Lewis Cantner is gone, now. It's safe to come out."

"He murdered my husband, Edgar. And, in a way, I am under siege. We all are. The Earth that created him is still out there, creating more just like him every day. Some of them will find their way here to Luna. They'll try to destroy our dream. I hate them all."

He shook his head. "Anne, it's not like that. It's—"

She gestured impatiently. "Look, dammit, will you at least come inside?"

He bowed slightly from the waist and stepped through the portal, which closed behind him. "Now, as I was saying—"

She waved a hand at him in frustration. "Oh, I know what you're saying. I'm not getting out. I've locked myself away since Alan was killed. I need to get out more. I—"

"Anne?" he asked softly.

When she stopped, he continued, "You have a whole city full of people out here who love you. Don't shut us out. We lost Alan, too. We don't want to lose you."

And she did the last thing he expected—she began sobbing.

Carefully, cautiously, he stepped across to the couch and sat primly next to her. He reached out for her hand, but she flung it aside and buried her face in his chest, crying as though she would never cease. It was a long time before she spoke again.

At last, she pulled back and said, "And *don't* give me any nonsense about my needing that . . . even if it's true. I'm sick and tired of hearing true things."

"Surely you don't want to hear lies."

"You know what I mean. So many people saying so many earnest, heartfelt, sad, sympathetic things. I just want to scream. I've got to raise a boy to be normal in a world that murdered his father before he was even born. I want to be able to walk down the corridors without people staring at me and whispering behind my back."

"Anne, you were the wife of the Commissioner of Crisium, the most powerful man in all Luna, and arguably all of humanity. Whether you like it or not, you're famous. You and your husband will go down in history with George Washington. Do you honestly expect that people will ignore you when you pass them in the corridor?"

Her reply was a long time coming. "No, I guess not."

"You've made more of a spectacle of yourself by going into seclusion than if you'd gone on with your life. By now, if someone catches a glimpse of you in a public place, it's a news event. Did you know that I get calls from people, just to tell me that you're out and about?"

"So the *Observer* puts in a paragraph that I've been seen. Big deal. Don't people have anything better to do with their time?"

"Than love you? Than worship the ground you walk on? Than want to shake your hand and tell you what a fine job you and Alan did of guiding this city and all of Luna? Anne, they'd be less than human if they didn't want to know that you're all right."

"They're getting along just fine without me."

"They'd get along even better *with* you. They need you. Hell, *I* need you, and I made a solemn vow to myself years and years ago that I'd never say that to another woman for as long as I lived."

"And just what do you need from me?" she demanded.

"Haven't you ever just wanted someone in your life? For no better reason than the fact that it makes the world a more complete place? Have you forgotten the use of the word friend?"

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"So what am I supposed to do? Hold a press conference and tell people that I'm no longer hiding?" She snorted. "I'll pass, thank you."

Edgar Rice smiled disarmingly. "Well, actually, I stopped by to take you out to dinner. That way, you see, no one will bother calling it in to the *Observer* because, obviously, I already know about it."

"But what about Travis?"

"The last time I checked, it was not against the law for mothers to carry their infant sons through the corridors of Crisium. Now, I can't guarantee that your son won't attract a certain amount of attention, but babies generally do that, just by existing."

Her resistance weakened, bit by bit. He had come prepared with answers for every objection on her part and met each with patience and occasional humor. In the end she gave in and Edgar Rice ushered her out the portal into the brightly lit, bustling corridors of Crisium.

Brian Stuckey flew down the road like a man possessed. He had driven all through the night, trying to get to New York ahead of Wyatt Mitchell. His eyes were dry and bloodshot. He kept licking his lips, as though it would help drive away this cold, burning certainty that he had done something . . . *big*.

Things would have been so much simpler if Mitchell had never been born. And if he had to be born, why couldn't he have chosen to lead a virtuous life? Given that he had gone the way he had gone, why, out of all the places in the world, had he had to live in Stuckey's apartment complex?

Damn.

It had begun simply enough. Stuckey had decided to walk the complex instead of calling around. He and his wife, Alice, wanted to start a weekly prayer meeting. Nothing much. Have some people over, talk a bit, pray a bit.

Stuckey had knocked. Wyatt Mitchell, a man he knew only slightly, had opened the door. Stuckey had stuck out his hand and introduced himself, then started telling Mitchell about the proposed prayer group.

A woman entered the room behind Mitchell. Dressed, or *not* dressed, depending on your point of view, in a very . . . revealing manner.

Stuckey had blinked, dimly hearing Mitchell thank him for offering, but that he was not a believer, himself—an atheist, actually. The woman came to stand beside Mitchell and smiled. Stuckey, stunned by the amount of flesh this woman was showing, had managed to stammer out something to the effect that he hadn't realized that Mitchell was married, and perhaps his wife would like to attend the meetings.

Mitchell had laughed, and told him that although Angela was free to do as she pleased, he doubted that she would come, as her projection could not leave the apartment. The rest ran together in his memory—merely a holographic projection from the household computer—a program that Mitchell had written in his spare time—wasn't she lovely, to which compliment she had responded by pirouetting in a wanton display of womanhood. It was enough to unsettle him in ways he hadn't felt since he was a teenager. With her shirt knotted up high on her abdomen that way, she'd been showing more flesh than he'd seen in a month of Sundays. And firm-looking flesh it had been, too.

He shook his head, trying to clear his mind of such base, carnal thoughts. Granted, women had worn a lot less sometimes back in the Twentieth, but that was then, and this was now. Women dressed properly these days and that's all there was to it.

The more Stuckey thought about it, the more he found to dislike. The idea that Mitchell might prefer a machine to a real woman was sick. Perverted. Not the sort of person he wanted living in a neighborhood where there were inno-

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cent little children. No telling what a man like that would do next. If he was in there cavorting with some, some . . . whatever it was, then he wasn't bonding with a woman the way God planned it.

And if that thing was alive . . . and she certainly *looked* alive, then the man had done something that was God's to do, and for mortals only to watch as a miracle. What he'd done was a sin. Why, either way, Stuckey bet he had her take off the rest of her clothes when no one else was around. Best not even to acknowledge the images that rose unbidden in the back of his mind at that thought. He'd have to do some serious praying to get God to take these thoughts from him. By the time he went to bed that night, he could scarcely think, there were so many things whirling through his head.

What a mess.

Nothing for it now but to finish the job.

Stuckey knuckled his eyes. *Damn* that Wyatt Mitchell! This whole thing was his fault from start to finish. Maybe the jury would even understand that the man was trying to do something against God's will.

'Course, it wouldn't hurt to have a good lawyer, too.

The restaurant was dimly lit and quiet. Their table was in the back, far from the portal. The waiter was respectful and unobtrusive. He brought the wine and vanished silently.

Edgar Rice cocked his head and grinned at Anne Lister. "Aren't you worried that someone will suspect us of romance?" he teased.

She grimaced. "What are you trying to do, scare me back into hiding?"

"Just trying to see if the Anne I once knew is still in there."

"And what's the verdict, doctor?"

"Too soon to tell. Ask me again after we finish this wine. Pretty good, isn't it?"

"It's excellent. What kind is it?"

"Oh, a modest little vintage. Rather subtle, don't you think?" he asked, swirling the glass under his nose.

"You're hiding something, Edgar. What is it?"

"That's a Lunar wine you're holding, Anne. And we're working on a brandy."

"We? You're in on this, somehow?"

"I own twenty-three percent."

She held the wine up to the candle flame. "If this isn't some kind of a joke, I predict good things for your investment."

"It's no joke," he assured her. "It's down on level eleven. For obvious reasons, we don't have a great deal of acreage under vine so this bottle is one of only a comparative few in existence."

She made as though to put her glass down. "Then we shouldn't—"

He wagged a finger at her. "Tut, tut, my dear. My prerogative. Owning part of a vineyard does have a few benefits. Say the word and I'll have a case brought by your tunnel tomorrow morning."

"As though I'd know what to do with such a thing!"

"Anne, we're on the threshold of becoming, not just the economic center of gravity of the entire human race, but a major cultural center as well. Did you know that we have a symphony now? I'm told that we're short a few chairs in the violas, but to my ear, they sound just fine. They just released their second recording to unanimous critical acclaim—and I'm including Earth's jaded critics in that. We're no longer just some hick town where a bunch of crazies live underground."

"You want something from me. What is it?"

"We need you, Anne. You were part of the team that brought us this far. We need your vision to go further."

"Sounds like everyone's been doing just fine without me, what with vineyards and orchestras springing up all over the place." Her tone was bitter and Rice thought he saw tears glinting in her eyes as she made a show of checking

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the sleeping infant in the carrier in the chair by her side.

He shook his head. "That's just paint-by-numbers. Filling in the spaces in the framework that you and Alan designed."

"Damn you, Edgar, you're trying to get me back into politics!"

"No, not politics. Not unless you yourself choose that."

"What, then?"

"Honestly, I don't much care. Start a think tank. Chair a cultural committee. Write an editorial column . . . I'll give you as much space as you want in the *Observer*. You can say anything you want. Tell people whatever you think they need to hear. This is bad. That is good. Do more of this and less of that. We need guidance. Direction. The new commissioner is fine, but he lacks that extra *something* that makes people jump up and get excited about life."

"And you think I can motivate people? The entire subtext of our conversation is that you don't think I've been motivating *myself*. How am I supposed to jump start Crisium if I can't even get traction in my own life? Edgar, I'm just biding time until they get Mars ready, then I'm leaving."

"And do what? Hide in a tunnel there the way you've been doing here? One tunnel's as good as another, Anne."

She jerked as if slapped. Just at that moment the waiter arrived with their food, saving both of them from what she had been about to say. After the waiter had gone, she sat chewing her lip, staring at her plate.

Rice took a deep breath. "Anne . . . I apologize. I overstepped my bounds."

"No, Edgar. We've known each other too long for that." She picked up her fork and prodded at her filet. "You want the truth? Part of the problem is that I don't know what to do with Alan."

He blinked. "I'm not sure I understand."

She made a small shrug. "They gave me a little box with his ashes. I didn't know what to do with it, so I just put it in the closet. I'd thought about spreading his ashes under the trees in Aldrin Park, but somehow that doesn't seem right. Alan belonged to all of Luna, not just Crisium, and I . . . I just don't know what to do with him." Her eyes were brimming again. "I do know that I can't take him to Mars. He belongs here. I need some sort of closure before I go on with my life."

Rice made to speak, but she shook her head. "Don't say anything right now. Let's just eat."

So they ate in near silence, speaking only to ask for the salt, or more wine. Afterwards, he walked her home and was turning to leave when she said, "Edgar?"

He turned back, eyebrows raised.

"I don't think I can be what you want me to be. I just don't have it in me any more."

"Can we try this again tomorrow? Wipe the slate and start fresh. If it helps, pretend that I'm a Jewish mother who wants to see that you're eating properly."

"And you'll pester me again, right?"

He gave her a good-natured smile. "I reserve that right, yes."

She sighed. "Damn you, Edgar Rice. Can't you just let me fade out?"

"You're not the kind to fade, Anne. You're the kind who needs to blaze."

She sighed again. "Just keep the trumpet fanfares to a minimum, okay? Besides, the racket would probably wake Travis." The child obligingly opened his eyes and raised a plump fist, then let it fall as his eyes closed again.

Sundown at a truck stop in Virginia. For a wonder, the snow had stopped, the clouds had broken, and the setting sun washed the snow with apricot-colored light, broken by deep blue shadows. There was a bus in the parking lot not far from the door. It had developed some kind of engine trouble and had just barely managed to crawl up the exit ramp from the Interstate. Another had been dispatched from Richmond, but wasn't due in until mid-evening at the

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earliest. In the meantime, the dozen stranded passengers were eating.

One passenger was being avoided by the rest. With the wise eyes of one who has watched humanity in all its glory and despair, the waitress noted the shy man no one would talk to. She also noted the frayed cardboard box that hid the cat. Smiling gently, she went back into the kitchen and found a produce box that already had holes in it, located the lid, and took it out to the booth where the man was slipping a scrap of food to the cat while he thought no one was looking.

"Here," she said. "I brought you a new box."

He literally jumped in his seat. "*Hai!* I mean, uh, hi."

She set the box on the table. "I'm sorry. I didn't mean to startle you."

The poor man was panting he was so scared. "I . . . I mean I d-didn't know you w-w-were there." He glanced down at the box, where a cat's paw was grasping through one of the crudely punched air holes, trying to find the hand that held the tidbit. He looked up at her, back down at the incriminating paw, then back at her, and blushed.

"It's okay, I love cats. Got three of them, myself," she said. She nodded her head towards the kitchen. "I'll get some more scraps. In the meantime, why don't you get your cat into this box? It's a little bigger and stronger than that one."

The gratitude on the man's face was so plain that it verged on pathetic. The cat would probably be better off, as well. Judging from the whiff she had caught, the cat had been deprived of its litter box for too long and had soiled the box. A clean one would suit all concerned just fine, thank you.

On the way back to the kitchen, she collected a few plates from folks who were done eating. She set aside the meat before scraping the rest of the leavings into the trash and placed it all into a plastic bowl used for takeout meals. This, she took back out to the man with the cat.

"Where are you headed?" she asked, as she placed the bowl on the table.

Such a simple question to bring about such an elaborate response. His mouth opened and closed and his eyes started darting back and forth as though he was checking for someone who might overhear him. "Um . . . N-N-New York," he finally said.

"Going to visit relatives for Christmas?"

His face fell. He shook his head, looking into his lap. "N-nobody to visit."

She bit her lip. Oops. Try again. "So what 'cha going to do?"

"Well, there's this m-man and this woman, and they need h-help."

Someone less kind might have laughed, thinking that this man was the one who needed help. The waitress found the idea touching.

"That's great," she said, and meant it.

A shy smile began. "Really?"

She nodded. "You bet. Everybody needs help sometimes. Some people—"

"*Miss!* Can I have some more coffee?" called a woman further down the aisle.

The waitress smiled once more at him. "I'll come back and check on you in a few minutes," she said, before fetching the coffee.

But then the dinner crowd came in, and the replacement bus arrived a little earlier than expected, having made good time once the skies cleared, and she never did get another chance to talk with the shy man with the cat. Oh, she patted him on the shoulder as she passed and smiled at him from three tables away, but she didn't even get to say good-bye.

The last she saw of him was as the freshly loaded bus pulled out of the lot, headed north. He was waving to her from the back window. She waved back, making sure that she stood where he could see her clearly, then went to bus another table.

But that wasn't the last she ever heard of him.

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The next morning, she slipped on glare ice in the parking lot as she got out of her car, and fell, spraining her ankle. Feeling ashamed to be missing her first shift in over a year, she allowed a co-worker to take her home. Deciding that the smart thing to do would be to take the weight off of her ankle, she gratefully collapsed on the couch, switched on the news . . . and gasped, remembering her brief encounter with the man and a cat in a cardboard box.

"I'm sorry," Angela said.

Wyatt Mitchell passed a slow-moving truck, then settled back into the right-hand lane before responding. "What do you have to be sorry for?"

"If it wasn't for me, none of this would have happened."

He exhaled noisily. "My darling woman, I brought this upon myself entirely. It's not as though you wrote yourself, you know. I—"

"I can write my own code, now. Good, clean code," she retorted in good-natured indignation.

"I know you can, but it wasn't that way to begin with. I wanted you. I wrote you love letters in computer language. That you would answer was as necessary as sunrise."

"Great," she teased, "Now he thinks he's God."

Mitchell chuckled, then rubbed gingerly at his side. "That would be a double irony—to have God exist when I didn't believe would be bad enough, but to turn out to *be* God would be a *real* shocker."

"If you were God, what would you do? Go home and fry those bastards?"

It was a long time before he said anything. "What if I overreacted, Angie? What if they would have simmered down after they got it out of their systems?"

"Can you honestly say that you would ever feel safe again? Not just in our apartment, but anywhere in the area. Not if you were sane. It's one thing to stand up for your rights, but another entirely to be outnumbered by a group of assholes trying to tear you limb from limb. You said one of them was the cop that wanted us to join his prayer group. If you can't trust the police, life gets scary very quickly indeed. So we hit the road. Shed no tears for the apartment. It was just a set of walls. Your job, granted, is a loss, but not at the expense of your peace of mind. If they were to come after you again, the price might be higher than a few cuts and bruises. Wyatt, this may or may not be the *best* solution, but it's a *good* solution, and we'll just have to live with that."

He pounded the steering wheel with his fist. "But I feel like such a coward! I lived there for eleven years, then cut and run at the first sign of trouble."

"Hey, I lived there longer than you!"

He did a double take, glancing at the blank computer screen. "What? You've only been up and running for the last eighteen months or so."

"Which is all my life, and that's more than you can say. Besides, I live faster than you do. I spend about seventy eons waiting for your every word, so by that yardstick I'm—"

"About ninety billion dog-years old," he finished for her. "And you know, for such an old hag, you don't look half bad."

"*Oh!*" she huffed.

"I'm sorry," he apologized. "I shouldn't have said that."

"Maybe flesh and blood is still better at some things, 'cause I for sure never saw that one coming."

"We've had the last couple of million years to evolve for it, Angie. Give yourself time, you'll learn."

"Well, then, Mister Pinnacle-of-Evolution, give me about ten minutes whilst I age another million dog-years."

"Just don't overshoot, okay?"

"You bet. Wouldn't want to leave you too far behind. I'd get lonely waiting for you to catch up."

* * *

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As soon as the portal opened, Edgar Rice knew that his work was cut out for him. Anne's face was sullen and angry.

"Let's go," she snapped, pushing past him.

He turned and ran to catch up with her. "Hey, Anne, what's wrong?"

"Nothing. I just want to make sure that I'm out where people can see me. See? I'm being friendly." She waved at someone going the other way on the slidewalk.

Not good. Not good at all. The brittle smile fooled no one.

He hurried a few steps until he was beside her. "Anne, stop it! What's wrong?"

Her hand dropped to her side and her mouth pulled into a grim, straight line. "I feel like a show horse. You've got me out on display now, so I've got to go through my paces so all these lovely people will see that I'm still here."

"Don't do this, Anne! Please!"

She turned on him, lashing out. "Can't you see that I'm not the one you want? You need Alan for what you have in mind. These people don't want *me*. They want Alan, and he's not *here!* They couldn't care less about *me!*" She stopped, breathless, on the verge of tears.

Rice sighed sadly, aware of a dozen pairs of astonished eyes as other people in the corridor turned to watch as the slidewalk whisked them through the corridors of Crisium. "Anne, can we at least get off of the slidewalk, rather than carry this . . . discussion throughout the entire city?"

Without replying, she stomped across the two slower lanes that separated them from the fixed sidewalk. Rice followed her with as much dignity as he could muster.

He met her on the sidewalk, looked her in the eyes, and said, "I have failed. I am sorry to have caused you such pain."

She began walking slowly. Rice fell in beside her. They walked silently for a few moments before she spoke. "Maybe you're right, Edgar. Maybe I do need to get out of myself, but I'm not sure this is the time or the place."

"I'm beginning to realize that."

She took a deep breath and released it. "Look, I'm sorry I acted the way I did. I think I've gone and made a very public fool of myself and hurt you in the process. I feel the way I feel, but that wasn't the way to handle it."

"It's all right," he said quietly.

She gave him a sheepish grin. "They won't have to call you about putting that in the news. You already know about it."

He nodded and smiled back a bit stiffly. "I guess so."

They were nearing the large portal leading to the Crisium Holmes Door. Anne glanced up at the traffic signs hanging from the roof of the corridor. "I think it'd be best if I just went home, paid off the baby-sitter, and gave myself a good talking to. I can catch a connector over to the B7 slide up here."

He nodded and was about to speak when the shooting began. He saw Anne's face cascade though four or five distinct expressions in the split second before she began to sprint towards the explosions reverberating down the corridor.

Social skills were not Wilbert Dinkins's forte. Never had been. Never would be. He was an only child of highly overprotective parents, and had spent his adult life living alone with no real friends and a night job that left him asleep when the rest of the world was on their feet interacting with one another. Hangdog and Jesus were his only companions.

So what happens when a full-grown man with no social skills enters a large room full of bustling, noisy people? He gets nervous. Very nervous. Sweaty-palms, deodorant-failing, dry-mouth nervous. And he stops dead in his tracks and tries to figure out how to cope.

Jesus, drat his hide, was no help. Quiet. Off the air. In this moment of need,

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Wilbert was left without his trusted guide.

Hangdog, of course, had nothing to offer. He was too busy trying to keep his footing in an unstable box held by a none too stable man.

Without consciously planning to do so, Wilbert sidled towards the wall and stood there staring out at all the people. This was like watching a movie or something, except that it was real. Sensory overload. Smells. He could *feel* them as they walked by—the floor vibrated under his feet. And the noise! The pure, unadulterated, unfiltered sound of a living crowd came at him like a thousand mosquitoes thirsty for his sanity.

Wilbert closed his eyes and wished ardently that there was some way to turn down the volume on reality. Hangdog picked that moment to exploit a weakness in the dilapidated cardboard box and slipped between the top and side, squirming free.

The sudden shift in balance, followed by a sharp reduction in weight, told Wilbert all he needed to know. His eyes snapped open as Hangdog skittered off towards the New York-Crisium Door, the only obvious clear space in the room.

It was the only way Wilbert could have overcome his fear. He bolted after the cat, running awkwardly, dodging between people, calling out, "Hangdog . . . *Hangdog! Come back here!*"

The commotion spread rapidly as the cat, frantic and frenetic after being confined in a cardboard box, sensed freedom. He sprinted on a zig-zag course, finally dashing between the legs of a man in black trousers.

Wilbert, seeing that Hangdog was about to cross over into Luna, dove for the floor, reaching for the cat's hind leg, his tail, anything. In doing so, he hit the man in the black trousers from behind, tackling him with all the effect, if none of the grace, of a professional football player. Wilbert and the man in black went down in a tangled heap.

Just as he hit the man, there was a tremendous bang, another, then another.

And all Wilbert could think to do was get up and apologize for hitting the man so hard that he exploded. Then he opened his eyes, for he had closed them as he fell, and discovered that he had a cat's-eye view of the Door, with Hangdog's rapidly retreating form headed for Luna. As the cat crossed the threshold, he lost traction when the gravity changed. Thinking he had hit a slick spot on the floor, Hangdog changed direction, or tried to. Suddenly his pads weren't connecting with the floor the way they should and he lost his balance, falling over on his side, sliding, spinning across the floor . . . right in front of a man on his knees on the floor, holding his head with his hands as though to stop the bright red blood already staining his shirt as he slowly keeled over.

That face was familiar.

Wilbert saw a man at the cargo desk drop a pair of leather gloves and run for the bleeding man.

Then his view was blocked as the man he had tackled twisted from the waist, extended his arm and pushed an enormous gun into Wilbert's face.

Wilbert had time to turn his head and bury his teeth in the man's leg before the trigger was pulled.

Mike Ordner heard the gun go off again, glanced across to New York, but kept running for the first man. As he slid to a stop, he was ripping his jump suit open. He slid one arm out of its sleeve, then used his knife to cut the fabric. This he folded back and forth and pressed against the wound in the man's head. He could feel faint stirrings as the man tried to breathe. "*Call for help!*" he shouted back over his shoulder.

By this time, others were arriving, Door personnel, tourists, businessmen, all trying to help, but mostly getting in each others' way. Then an imperious voice cut through the crowd like a knife. "Get out of the way! You! Go for help.

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You! Get that pallet over here in case we need a stretcher. Everybody else clear out. Do it!"

And knees came into Ordner's field of view. As they sank to the stone floor next to him, a face descended into view. "Hello, Miz Lister," he said.

She blinked, then recognized him. "How bad is he, Mike?"

He shook his head. "Not good. What about the other guy?"

"What other guy?"

He nodded his head towards the New York side of the Door. "Some other fella got it over there."

It seemed to him that her face broke apart and reformed inside of a second. "This can't be happening," she whispered.

"Ma'am?"

"Never mind. You hold this one and let me check on the other." With that, she leaned down until her mouth was next to the man's ear and said, "Don't you die! You hear me? Help's on the way." With that she sprang to her feet and crossed over to New York, parting people like water.

In minutes, she was back. "He's alive, but badly hurt. They say he tackled the man who shot this one and got shot for his troubles."

"Whoever he is, he's got guts if he'll jump on a man with a gun."

A flatbed electric cart stopped next to them and Ordner relinquished his position. It was only a matter of minutes before both victims had been gently deposited on the cart and taken away. He and Anne then walked over to where several men had a firm grip on a man with a dark crew cut. Edgar Rice caught up with them as they crossed the Door threshold.

"Who are you?" Anne fired at the assailant.

"Nobody you know," he spat.

She smiled, and a fierce light came into her eyes. "Then let's get acquainted, shall we?"

* * *

The hospital room was dimly lit, quiet, and plain. Tubes and probe leads snaked off of and out of the man's body. Anne Lister sat motionless in a chair by the bed, watching the traces on the readouts. Every time the man breathed, Anne allowed herself a breath. She was faint from lack of oxygen. She could not understand how he could live on so little air, yet she continued. One breath for him, one for her, as if it would allow her to absorb some of his pain.

His name was Wyatt Mitchell, and no one could find out why he'd been shot. The would-be murderer wasn't talking.

She had been by to see the other victim, the one who had tackled the man with the gun. He would live. The shot had entered through the top of his left shoulder, grazed his lung, and exited through his lower back, just above the kidney. He had been asleep when Anne had dropped by. She had sat watching him for a time too, struck by the look of innocence on his face.

Mitchell was going to have an uphill battle if he was to survive. According to witnesses, the assailant had fired one clear shot before being tackled. The next two shots had gone wild, not hurting anyone, in spite of ricocheting around the stone-walled Crisium terminus of the Holmes Door. That one shot, however, had nearly done the job. The surgeons had gone in and done what patchwork they could. Now it was up to Mitchell.

And to Anne, who willed him to take another breath, so that she could. Over and over, she silently urged that next breath on him, whether he wanted it or not. Beat by beat, she willed his heart to keep going.

All through the first night, she stayed by his side, leaving only to check on the other man, whose name no one knew . . . and no one had the courage to tell Anne Lister, widow of Alan Lister, to leave.

Nick Loeb was the resident computer expert on the Crisium police force. To-

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day's hot case was a shooting at the Door. Two men down, gunman in custody. They'd like to know what happened, but the gunman wasn't talking, and neither of the two victims were conscious. All they'd managed so far was to ID the first victim. Police on Earth were using up shoe leather, but had yet to forward any results. Given the history of uneasy relations between law enforcement agencies on Luna and Earth, it was anything but a foregone conclusion that they would share any information that might come their way.

The other victim, the one who had almost certainly saved Mitchell's life, had been carrying a cat—currently dozing on top of the refrigerator in the break room after taking a crap in the chief's hat. Lacking the technology to connect with the cat's mind, they started through everyone's baggage.

Lo and behold! Mitchell had a computer.

Enter Nick Loeb.

Loeb took the portable in one hand and a cup of coffee in the other and strode down the corridor to his tiny computer lab, not much more than a closet, really. First, he examined the computer from the outside; a normal Stella Model 320. Damn sight bigger than the average man on the street carried around, but not yet in the mega class. Loeb pressed the power button and turned to reach for his coffee.

"Hi!" the computer said brightly.

"Hi," Loeb replied reflexively, thinking that he was speaking to an ordinary personality module.

"Wyatt?"

"Nice voice you've got there. Who made you?"

And then the computer started getting weird. "Who are you? Where's Wyatt?"

Not part of the standard pattern for a personality module. To begin with, they didn't get suspicious when they heard a new voice—they were designed to fall all over themselves trying to be helpful. They also did not refuse to answer a direct query.

He frowned as he sipped at his coffee. "Um, I'm Nick. Who are you?"

"Where's Wyatt?"

"Aren't you supposed to answer me if I ask you a question?"

"I will if I damn well feel like it. Where's Wyatt?" the computer repeated.

Nick grunted. He'd never heard of someone setting up a routine like this, but it shouldn't be too hard to do. If you don't hear a familiar voice print when you boot, ask for identity. He reached out for a plug, slid it into the port on the back of the portable, and told his terminal to find a way over, under, or around that pesky protection problem. Then, anticipating that it would take at least an hour for the city computer to find a way to do what he'd asked, he stepped down the corridor to his office to catch up on some paperwork.

To those involved, it almost seemed that for twenty-four hours, time stood still. The customary accusations flew back and forth between Luna and Earth, as each blamed the incident on the other's lifestyle, morals, and lack of self-control. But that was more or less de rigueur when anything went wrong.

In the background, police were already in motion. They knew, more or less, what had happened, but the why was missing . . . or in the manner that the police looked at it, they had the weapon and the opportunity, but no motive.

Officers backtracked on Earth, tracing Mitchell's movements. When they discovered that his neighbor Brian Stuckey had been missing for exactly the same period of time as Mitchell, they made the connection and the unknown assailant acquired a name. They still had not found out about the beating; Mitchell had told no one, and those who had attacked him weren't talking.

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Earth wanted Stuckey back. He had shot Mitchell from the New York side of the Door, though Mitchell himself had been in Crisium at the time. They were also aware of Luna's ruthlessly efficient methods of dealing with murderers. No endless appeals, no pleas of insanity, temporary or otherwise, and no turning back. Whether Stuckey had actually accomplished murder was yet to be seen, but rumor had it that there was already a bullet with his name on it in a locked drawer in the Crisium police chief's desk.

But other forces were afoot that neither side was aware of and things were about to get much more complicated. . . .

Edgar Rice was in his office at the *Crisium Observer* when his terminal quit responding. He grimaced, leaned out the door of his office and said, "Darlene? See if you can find Carter. My terminal's on the fritz."

She turned and looked up at him, frowning. "Mine too."

"Oh. Well, listen, I'm going over to the hospital and talk to Anne. While I'm out, I'll probably go ahead and eat lunch, so just tell anybody who wants me to take a number, okay? I'll be back in an hour or two."

"All right."

Just as he rounded the corner, her voice floated down the corridor after him. "I can't seem to call anywhere, either, Edgar."

"Probably some damned fool cut the fiber link into the office. Carter'll find it."

"Okay. Have a nice lunch."

"Bye," he called, and strode out the portal.

On the way over to the hospital, Edgar Rice noticed that all five lanes on the eastbound slidewalk over to the Core seemed to have quit. People were having to walk under their own power on the belts that normally carried them effortlessly from one part of the city to another. Westbound seemed to still be working, though.

Once at the hospital, he found Anne still in Mitchell's room, rocking Travis slowly back and forth after feeding him. She looked up as he entered. "No change."

He went to stand by her side. "How about the other one? Has anyone figured out who he is yet?"

She shrugged. "No identification. Just the cat, a wad of cash, and a picture of a woman." Anne shook her head. "This man makes me so sad."

Rice decided to take the bull by the horns. "Because it reminds you of when Cantner shot Alan?"

"Yes," she admitted quietly.

He studied the heavily bandaged head, looking to see if there was any physical resemblance. If there was, it was not obvious to him. He decided that it must be the circumstances that were dictating her response. "Anne, I don't want to take you away from your post, but you need to eat."

She looked down at Travis, at Wyatt Mitchell, then back up at Rice. "I guess so. After all, we were supposedly on our way to eat when all this came up."

He smiled grimly. "Well, actually you were peeling off, headed for home as I recall, but the invitation still stands if you'd like."

"That seems like such a long time ago. What time is it now?" she asked.

"Nearly time for lunch. It's been almost twenty-four hours since I came to get you yesterday."

Her brow furrowed. "Seriously?"

Suddenly suspicious, he asked, "When's the last time you slept?"

"I dozed off for a bit, but . . . I suppose that explains why I'm so tired."

"If you're not going to sleep, you should at least eat."

It took them nearly fifteen minutes to get to a restaurant on the level above them—a trip that normally should have taken less than five. Traffic from the stopped slidewalk that Rice had noted

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on the way to the hospital was being rerouted through one in another corridor, but that had just failed also, further complicating things.

Wilbert Dinkins was awake, but . . . not. It felt a little like a dream, but more real. And everything smelled funny, but in a familiar sort of way.

There was a pain down somewhere in his back on his left side, but it seemed distant, like it was happening to someone else. He wished that it would go away so that he could go back to sleep. Hazily, he remembered the last time he had been this tired, the winter before last when he caught that flu from his supervisor and had fallen asleep sitting in his living room thinking that he ought to get up and go to bed, but somehow couldn't get up enough energy to even open his eyes.

Why his back hurt wasn't real clear to him. He decided that if it was a big enough problem to keep him from going to sleep, maybe he'd better think about it some more. It seemed important, somehow.

Those smells, too. It wasn't like cooking at home in his apartment. It wasn't like the solution he used to clear stopped toilets at work. It wasn't quite like the way grass smelled after it was cut. But he'd smelled it before.

Where?

He thought about opening his eyes, but it was so hard and he was so tired and he just didn't think that—

"You were hurt, Wilbert," came Jesus's voice, all nice and calm and quiet-like.

Balm to his soul. He almost sighed out loud with relief. It was a good thing to have Jesus back around.

"You did the right thing, but you got hurt doing it."

It felt nice to have Jesus tell him he'd done something right. Sometimes Jesus was disappointed in him, and that made him feel bad.

"But what happened?" Wilbert asked. Or tried to. His tongue was the size of the baseball bat his grandfather had given him when he was a boy, and it didn't come out sounding like words at all.

But Jesus understood, just like always. "There was a man. And a woman. They needed shelter."

That's right. The manger. He remembered looking at the manger. Then there was the long bus ride to New York. He remembered the walk to the Holmes Door terminus. It had been cold, but it felt so good to be able to stretch his legs. He remembered coming inside the Door place and seeing a lot of people and . . . and . . .

"*Hangdog!*" he screamed.

There was a police officer stationed outside the hospital room with the John Doe, just as there was one outside Wyatt Mitchell's room. Frankly, the officer thought that it was just wasted effort. Nobody was going to try to hurt the guy. But until the chief got some answers, he wanted to make *real* sure that nothing else happened. And so there were guards.

He was seated in an uncomfortable blue hospital chair tipped back against the wall next to the portal into the room. He was nearly asleep when the man screamed.

The officer catapulted off the chair so fast that it fell to the floor, bounced, and rocked back up to hit him in the shin as he spun towards the portal. He promptly began cursing, kicked the chair out of the way, and swatted the palm lock for admittance, certain that he would find that some ninja-like assassin had crawled through the air ducts to silence their star witness forever.

Instead, what he found was the man sitting bolt upright in bed, eyes bulging, repeating one word over and over. The word was Hangdog.

Whether that made things better or worse was open to question. What the hell was Hangdog? If, as some had speculated, there was some sort of covert

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operation going on, then it was probably the code name of an agent, or perhaps the name of the operation itself.

The officer leaned back out into the corridor to shout for a doctor, but people were already hurrying his way; once the portal had opened, the man's voice had carried quite readily. He turned back to the John Doe.

"Hey, buddy. Easy, easy," he said, trying his best to sound soothing. He held out his hands in a placating gesture. "Please, man, I'm not going to hurt you. Okay? Just tell me about Hangdog."

"*Where's Hangdog?*" the man in the bed demanded, more of a yell, now. Wide, staring eyes.

"Uh, look, I need to know who Hangdog—"

"My *cat!* Is he all right? Oh, where's *Hangdog?*"

"What did you *do* to him?" demanded the first nurse on the scene, as though it was all his fault that the John Doe was coming unglued.

"I didn't do anything. He just started yelling."

"*Hangdog!*"

The nurse started to say something, but the officer clapped a hand across her mouth and said in his most reasonable tones, "Listen, buddy, you've got to calm down. Okay? Please?"

"*Hangdog!*"

Enough is enough, the nurse was tearing at his hand and the man in the bed wasn't getting any better. "*SHUT UP!*"

The nurse jumped and the man in the bed stopped in mid intake of breath.

"That's better," the officer said calmly, just as another nurse and a doctor arrived together. He glared at them and said, "Not a word out of either of you." Then he turned back to the John Doe and said, "Is Hangdog the name of your cat?"

The man in the bed nodded meekly.

"About so big?" He used his hands to describe a cat-sized volume of air. "With stripes and a little white patch here?" He patted his chest.

The man in the bed nodded.

"Well, he's fine. We've got him down at the station and he's fine. Okay? You understand me? He's just fine. Last I saw, he was asleep. Okay? Asleep, but fine. He's not hurt or anything. Got that?"

The man nodded once more, looking relieved.

"All right. I want to know just one thing, then the doctor here is going to want to look at you to see if you busted a gut hollerin' like that. Ready?"

The man nodded.

"What's your name, buddy?"

"Wilbert."

"Wilbert, what's your last name?"

"Dinkins."

"D-I-N-K-I-N-G-S?"

"No G."

"No G. Great. Now you be a good fella and let this doctor look you over, okay? You've had a little too much excitement to go making a scene like this. You have to do what the doctor says, okay?"

"Yes, sir."

The officer nodded the nurses and doctor forward and waited more or less patiently while they fussed over this Dinkins creature who cared more about his cat than the fact that a bullet had drilled a hole in his torso yesterday morning.

On the way out, the doctor told the officer that he could have five minutes to talk to Dinkins, no more.

He stepped over next to the bed. "Listen, Mr. Dinkins, I need to know what happened yesterday."

"Wilbert," the man in the bed corrected, speaking very softly. "Everybody calls me Wilbert."

"Okay. Sure. Wilbert, tell me what happened."

"Hangdog got out of the box."

"The cat."

"Hangdog got out of his box."

"Okay, then what?"

"He, uh, ran between this man's legs."

"And?"

"Well, I . . . I tried to catch him. I jumped. And I hit a man, and he exploded."

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The officer drew back. "*Exploded?* Who exploded, the man or your cat?"

Wilbert looked horrified. "The man, of course. Hangdog doesn't make loud noises. He just, uh, poops on my pillow. That's the only bad thing he does. Promise."

By this point, the officer was beginning to realize that not all of Wilbert's mental air locks were properly sealed, but he had no choice but to proceed. He decided to take a different tack.

"You were coming to Luna?" he prompted.

"Well, I guess."

"You guess?"

"That's where he said the man was going."

"Which man was coming to Luna?"

"The man on the news. The one they beat up and chased away."

"What man is that? What's his name?"

"I don't know."

"So you were following this man from the news to Luna?"

Wilbert nodded.

"Why?"

"Jesus told me to. . . ."

By the time Edgar Rice and Anne Lister left the restaurant, it was clear that the city was having major problems. All the slidewalks were still. Lighting was out in some sections of the city. Communications were spotty at best and deteriorating. Worst of all, people were milling about, adding to the confusion.

They arrived back at the hospital only to find it in an uproar, as well. In their absence, the John Doe had acquired a name, demanded his cat, and claimed that he talked to Jesus in his head. To say that he had caused a stir was an understatement.

The hospital had its own power and internal communications, and so was spared the problems outside. However, it was unable to communicate with the ambulance carts or any other medical personnel out in the city.

"Is everything breaking down at once?" Anne demanded of Rice.

Rice shrugged. "I don't have any idea. I don't remember ever seeing more than one slidewalk break down at a time. And I've never seen the lighting fail."

"Me either . . . " Her voice trailed off. "Wait a minute . . . all those things are under control of the city computer."

Rice raised an eyebrow. "The *lights?* Then why are some working, and some not?"

Anne, deep in thought, stirred. "Hmmm? Oh, it's only the side corridor lights that are going out. The main corridor lights stay on all the time—they're tied directly into the main power grid—but the side corridors are dimmed at night. Saves money."

"And the city computer is what does the dimming," Rice guessed.

"Right. But *all* of the slidewalks, and *all* communications are under control of the computer."

He was nodding. "Got it. What do you want to do about it?"

"*Me?*" she asked, surprised. "Nothing. Let the Commissioner worry about it. I'm not in the hot seat any more. Let's go see this man who talks to Jesus."

"Surely, you don't think he actually talks to Jesus, do you?" Rice asked.

Anne shrugged. "If he doesn't, then he's got a screw loose. If he does, then I've got a few bones to pick with the Almighty, and this man's going to be my phone. . . ."

Like the hospital, the city computer had its own tunnel, its own power, and its own small staff. Right now the head programmer was perched on the corner of his desk listening to the Commissioner.

"Let me get this straight," the Commissioner said. "The city is falling apart because there's something wrong with the computer, and you're telling me that there's nothing you can do about it. Did I get that right?"

"That's about the gist of it."

"Then what the hell am I paying you for? To sit here and play tiddledywinks?"

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The programmer sighed. "Look, once upon a time, if the system messed up, you'd stop it, then restart it. If things were really bad, you'd go back to the last backup and restore from that. We can't do that. We depend on redundancy now, not backups. If something happens that bridges over the fire walls between the redundancies, it's up to the system to handle it."

"So what do *you* intend to do?" the Commissioner hissed. He was more than angry, he was on the verge of physically striking the man.

"Nothing. Around thirty years ago, the people who created the operating systems began writing in code so the program would repair itself in the event that something went wrong. Protection against viruses, worms, HEATS, ANTS—all that is supposed to be fixed by the program. So we wait for the system to heal itself."

"I don't believe this," growled the Commissioner in disbelief.

"If you want an analogy, it's like the evolution of living creatures. We have now reached the point where computer operating systems have reasonably sophisticated immune systems and are on the verge of becoming self-aware. Hell, there are programs on the market that people claim are *already* self-aware, but the ones I've seen so far haven't convinced me."

"And so you stand here and muse about conscious computers while the city falls apart around us? Consider yourself relieved of duties, mister!"

The programmer grinned disarmingly. "No problem. I've never particularly enjoyed working for you, anyway. Now, Alan Lister . . . *there* was a man who understood the difference between wishes and reality. You've got a lot to learn about the real world . . . sir." And still smiling, he turned and walked out.

The Commissioner seethed and steamed, but could not get the two remaining programmers to do anything either. One of them finally said, "It's like he said, we have to be patient and give the system time to heal itself."

"And if it doesn't work?" the Commissioner snapped.

"Then all the king's horses and all the king's men won't be able to put Humpty-Dumpty back together again."

Meanwhile, Nick Loeb was frowning at the portable computer in his lab. He still had power, but the main system had crashed before it could finish the task of circumventing the protection program.

Its screen remained obstinately black. Even when the voice had spoken to him, there had been no image to go along with it. He wasn't like some people. He didn't need a bunch of pixels dancing on a screen in order to give the illusion of life to an inanimate object. In some ways, it was just a distraction. Either way, as long as the computer did what he wanted, he was content.

He shrugged. The terminal in the computer lab, unlike most, was a fairly powerful system in its own right, and was still running. He pulled a chair around and sat down. "Computer, display the log of the password analysis."

A line by line readout of what had occurred since he had plugged the cable into the back of the portable appeared on the screen. First, there was a query from the main system to determine which interface protocol they would be using. The portable had responded with the requested information. So far, so good. All this was being handled on a hardware level on the portable's part, hence not subject to password blockage. The main system had then inserted a tiny program into the small dedicated processor that governed communications through the plug in the back. A beachhead had been established. That tiny program had probed at the internals of the portable until it had found a way out into the rest of the system, at which point it sent that information back out to the main system and erased itself in order to make room for the next tiny

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program to be inserted, one which would have commenced the assault. With luck, there would have been no password protection on the back door—most people simply never thought of it.

And that's the point at which things started going wrong.

The next line was gobbledygook.

The line after that showed a transfer beginning, not from the main system to the portable, but from the portable to the main system. Something big.

The packet that contained the address should have been only ten bytes, instead, it was several thousand. The damned portable had reversed the strategy on him, uploading a Trojan Horse on the back of the address packet—almost certainly a miniature program to turn his computer in the computer lab into a conduit into the main system for Crisium itself.

Cold sweat began to bead on his brow.

His first instinct was self preservation. "Computer, delete the log file."

"*Soooo* sorry, Nick. Your access has been revoked."

And his terminal's screen went black.

But not before he saw her face.

If Nick Loeb had acted immediately, New London and Besselton might have been spared. Instead, he dithered, wasting precious time trying to decide how best to save his job.

New London had been built by a European consortium, unlike Crisium, which had its origins in a NASA project. Different design philosophies had dictated different solutions to the engineering problems posed by building an underground city. New London's lighting was all automated, and all went out at once. Their air, however, was controlled by an autonomous system. As soon as the lights went out, an alert operator at the air plant severed the connection between the main system and the one controlling the air the hard way. He took a flashlight into an access tunnel and manually unhooked the cable. Communications, however, had failed, so he was unable to call his counterparts in Besselton to warn them.

Besselton, like New London, had been started by a consortium. American, in this case. The planners had used as many parts of the public domain plans for Crisium as possible in order to save money. Part of what they had borrowed was the infrastructure for the air and lights. Both failed in short order, as well as the Holmes Doors to Crisium and to New London, thus isolating the city physically, although its communications remained functional for a while longer.

The first fatality was a construction worker in Besselton standing in the mouth of a freshly cut corridor above a six meter drop into a ventilation shaft. When the lights went out, he instinctively stepped away from the edge, but backed into the path of an oncoming electric truck that did not have its lights on because it hadn't needed them in the brightly lit corridor.

Anne Lister was besieged as soon as she entered the hospital. "Ma'am, we've heard that there's a woman who got trampled when the lights went out on level four, but we can't get in touch with any of the ambulances." "Mrs. Lister, I hate to bother you, but we're having trouble with our water . . . yes, power and internal communications are still fine . . . we think water pressure failed out in the city due to the loss of power—the pumps must have stopped . . . our sewage, too, I'm afraid . . . if we don't get this corrected soon . . . " "There was a work crew in the access under level seven, and one of them got hurt . . . we got a cart to them, but now the cart can't get back to us because of all the people in the corridors . . . the last we heard, he was losing blood, fast, and those ambulances don't carry much . . . "

An ever growing throng of people

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trailing in her wake, Anne plowed doggedly through the corridors leading to the room of the man who claimed to talk to Jesus. Finally, at an intersection with another corridor where she spied another contingent of people waiting for her, she stopped and held up her hands for silence.

When the small crowd surrounding her fell quiet, she spoke. "Listen, I'm aware that we're having problems. But, please, I'm not in office any more. I'm not the Commissioner . . . I'm not even the Commissioner's wife." Her voice cracked, and she paused to swallow hard before going on. "I appreciate your confidence in me, but there's nothing I can do. It's up to the Commissioner. He's the one who you should be talking to."

"Ma'am, we tried. I went, myself. He wouldn't see me, even when I told them I was from the hospital, and that we needed help."

Anne's lips parted as though she were about to speak, but she closed them and shook her head. "I'm sorry. There's nothing I can do."

She turned and walked quickly down the corridor, leaving Edgar Rice scurrying to catch up.

"Anne? Anne!" He called after her.

She made no reply, and he broke into a jog. When he caught up with her, he said, "Don't you think you were a little hard on them?"

"Hard on them? All I ask is to be left alone, Edgar. They elected a new Commissioner. It's time for them to put him to work, that's all."

"From what the man said, they tried."

She shrugged. "Not my problem."

He snatched her shoulder and spun her around to face him. "Dammit, woman, it *is* your problem! You live here, too. If this city falls, for whatever reason, you'll suffocate just like the rest of us. Can't you see that?"

She closed her eyes, took a deep breath, and resumed her path down the corridor without a word, Travis's carrier in her right hand, her left clenched into a fist.

Rice made no move to follow her. "Anne," he said to her retreating back, "I know you hurt. But lashing out at others won't make the pain go away."

Ignoring the wide-eyed guard, she slapped at the palm lock into the room and disappeared.

Wilbert Dinkins heard voices outside his room, but he didn't pay any attention. When the door suddenly jumped open, it scared him.

A woman entered. She had a funny expression on her face, like she was unhappy about something, but then she smiled at him, so he smiled back. It was that simple. Nearly everybody liked to be smiled at, so Wilbert did his best to accommodate them.

"My name is Anne. How are you feeling?"

He thought about that for a few moments. Actually, right now he felt fine—kind of drifty-aroundy, like nothing really mattered. Even though he remembered a man pointing a gun at him and shooting it, the pain he felt was not nearly bad enough to justify making faces the way people did in the movies. "I, uh . . . I'm fine, I think."

She smiled again, a small, sad smile. "That's good." She moved over to a chair and sat, placing a carrier with a baby in her lap. "Listen, Wilbert. I'd like to know about what happened. Will you tell me about that?"

And so he told her the whole, long, confusing story. Jesus and Hangdog and the nice waitress at the truck stop, all of it. And she listened without interrupting even a single time, which made him like her even more, because he was so used to being ridiculed when he told a story, especially if he told people that Jesus had said something.

After he had finished, she said nothing, just sat there, occasionally patting the child.

"Uh, Anne?"

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"Hmmm?"

"Why did you want to know about all that stuff? About the man and everything?"

She stirred as though coming back from a long ways away. "Oh, well, you see, we're still trying to figure out what happened at the Door yesterday. Wyatt Mitchell, the man who was shot in the head, hasn't woken up yet, and the man who shot you won't tell us anything."

Wilbert looked apologetic. "I'm sorry. I don't know him. I don't even really know Mr. Mitchell. I was just doing what Jesus told me to do."

"Well, you may have saved Wyatt's life, Wilbert. That was a brave thing to do. Everyone here in Crisium thinks you're a hero."

"Crisium? I'm in Crisium? But I was in New York. How did I get here?"

"We brought you to our hospital when you got hurt."

He suddenly looked worried. "But I never bought a ticket! They'll be mad. *You'll* be mad. I didn't pay to get in." He subsided into an uneasy mumbling. "Oh, I'm in *trouble*. I always pay my way when I get on the bus."

"It's all right, Wilbert. Nobody's mad at you."

Confusion plain on his face, he said, "But . . . promise?"

"Promise."

He thought about this for a while. "I guess that's why I feel so floaty, then. There's no gravity here."

She chuckled in spite of herself. "There's a little bit. It's just not as much as you're used to."

He raised an arm and let it drop. "I guess so. Huh." Then he giggled. "And Hangdog looked so surprised when he went through the Door and he fell down." Suddenly sober again. "Anne, you've got to check on Hangdog for me. They won't let me look after him."

"Where is he?"

"The policeman said they've got him."

Anne nodded. "I'll check on him." She rose from her seat. "Wilbert, have you thought about what you're going to do? After they let you out of the hospital, I mean."

"Well, I guess I'd better go get Hangdog."

"Other than that."

"I suppose I'd better go see that Mr. Mitchell—him and that lady that was with him."

Anne shook her head. "As far as I know, there wasn't any lady with him when he got here."

Wilbert looked perplexed. "They were acting like she was a computer or something, but she looked real to me."

Anne shrugged. "I'm sorry. I don't understand." She turned to leave.

Wilbert's voice stopped her at the door. "Anne, do I know you? You look real familiar to me. I just can't figure out why."

She took a deep breath. "I used to be married to Alan Lister. He was the Commissioner here in Crisium."

Wilbert nodded wisely. "Now, I remember. You were always on the news. Lots of people didn't like you, but I always thought that the things you did made sense. Your husband got killed, didn't he? A bad man killed him."

A momentary look of pain crossed her face. "Yes, a man named Lewis Cantner shot him."

He shook his head. "I'm sorry, ma'am. At least now I know why I thought I knew you. You and your husband always did the right thing."

Anne slipped out before he could see the tears in her eyes.

Samuel Watts, Crisium Chief of Police, leaned against the wall, arms folded, regarding the man in the chair closely. Such a smug look on his face as he sat there. Looked like he thought he had all the answers. Well, there were answers, and then there were answers.

Watts spoke. "So you followed Wyatt Mitchell to New York. How did you know where he was going?"

"God told me," the man snorted.

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Watts rolled his eyes. "Look, Stuckey, we've already got one fellow in this who hears Jesus in his head, but you don't seem like the type. Want to give me a more nuts and bolts answer?"

"He called his parents. Told them where he was going."

Watt's eyebrow raised. It was the first non-smartass answer he'd gotten out of the man. "And how, just out of curiosity, did you happen to know what he told his parents?"

"I had a leech on their phone. It was a cinch he'd call them, sooner or later. It was sooner."

"I don't suppose it crossed your mind that it takes a court order to put a leech on someone's line." Once upon a time it had been called wiretapping, but when people had started getting audio calls over the net, ordinary wiretaps had become obsolete overnight. Leeches were programs that performed the same function.

Stuckey just stared.

"But, being a cop, you figured you might as well use a leech. You had access, right? Why not use one? I mean, compared to murder, a leech is practically legal by comparison." Watts shook his head. "People like you give cops a bad name."

"Just protecting the public. Part of the job."

"*Harrumph!* Killing someone is protecting the public? Just what did Mitchell do that was such a threat to John Q. Public?"

"He's an *atheist!*" Stuckey spat.

"That's a crime on Earth? Since when? When I worked in Boston, freedom of religion was still part of—"

"Exactly! Freedom of *religion* . . . not freedom to be an atheist! It's disgusting."

"And so you thought you'd rectify the problem. Is that it?"

"Haven't you been watching the news? People in America are getting fed up. The morals of our country have degenerated to the point where we can't even see our neighbors in their homes without getting offended. Do you know what Mitchell had in his house? A woman, nearly naked."

"Is this the computer program I've heard about?"

"Life is God's alone to give. Mitchell has given that computer life. It's hubris, is what it is."

Watts chuckled. "I've heard a lot of sales hoopla over the last few years about programs that are alive, or conscious, or whatever, but if you ask me, that's all it is—sales talk. So what's wrong with Mitchell making up another program and trying to sell it? It's a hot category. People are making lots of money doing that. Don't you believe in capitalism? Seems to me I recall that being one of the cornerstones of America . . . right up there with God, Mom, and apple pie."

"You should have *seen* that thing! Brazen! I'd never allow my daughters to go around dressed like that."

Watts shrugged. "Okay, then don't. I still don't see how this computer image was harming you, or your daughters, or anyone else, for that matter. She, or it, was inside, right? The only way you ever found out about it was to go knock on Mitchell's door. It's not like she came out and danced naked on your front doorstep."

"It's immoral," Stuckey insisted sullenly.

Watts looked thoughtful. "You know, that's something that's always confused me. Why is it that religion teaches tolerance, but practices intolerance? Teaches love, but practices hate. Teaches understanding, but practices ignorance. Come on, enlighten me. How do you justify that?"

"We don't practice hate! Where'd you come up with a screwball idea like that?"

"Look at the Mid-East. They've been killing each other over religion for thousands of years. The Crusades were nothing but sanctioned slaughter of people who didn't believe what the Christians

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did. In World War Two, millions of Jews were killed, for no greater crime than being Jewish. And here you sit, telling me that you shot a man because he told you he was an atheist. You call that love? Sorry, I don't buy it."

"God said, no graven images."

Watts frowned. "Wait a minute. Seems to me that people weren't supposed to *worship* graven images. Now, if Wyatt Mitchell is an atheist—"

"Told me so, himself."

"—Then he doesn't worship anything at all, much less a computer program."

"I'm just carrying out His will."

Heaving an exasperated sigh, Watts shook his head. "Just following orders, huh? That's a pretty thin excuse, especially for someone who can't even claim that he heard God tell him to do what he did. At least this Dinkins character has a direct line."

"Yeah, and from what I've heard, he's crazy as a loon."

Watts pushed off from the wall and stood staring down at Stuckey. "So what makes you better than him? Both of you claim that you're doing what you're told. For my money, Dinkins, for all that he may not be real smart, is worth ten of you."

Stuckey just sat and glared as Watts turned to go.

Samuel Watts caught Anne Lister in the corridor at the hospital. "Hey, did anyone tell you that Mitchell woke up?"

She shook her head. "No. Can we talk to him?"

He nodded. "I came down here to talk to Dinkins, but I think I'll start with Mitchell instead."

They made their way back down the corridor to Mitchell's room, slipping inside quietly. When he heard their footsteps, he slowly turned his head to look at them. "Hurts like a bitch when I do that," he croaked. "Can you come over here near the bed so I don't have to move?"

They hastened to comply. Anne introduced herself and Watts.

The one eye not covered by bandages squinted at her. "You're the Commissioner's wife."

"Well . . . not any more."

"Oh. Right. Sorry. I'm not sure all my brain cells are working. Um, can you tell me what happened? All I know is that I crossed over into Crisium and got kicked in the head by a mule. Now I'm here . . . wherever here is."

"You're in Crisium," Anne told him. "In the hospital. A man named Stuckey shot you."

Mitchell's eye clouded. "*Brian* Stuckey?"

She nodded. "Your neighbor, it seems."

The eye closed. "*Whew* . . . you'd have thought he'd have been satisfied to beat me half to death. Wasn't happy about Angela." The eye opened again, travelled around the room. "Where's my computer? She's probably pretty pissed at me for not talking to her for . . . how long? What's today?"

"Tuesday."

"Oh, boy," Mitchell breathed. "Am *I* in trouble. She's going to want to know where I've been."

Anne smiled. "I think one look at you will get you off the hook. It's pretty clear that you haven't been out having a good time."

"Your computer is down at the station," Watts added. "When all of this started, we didn't have any idea as to why you were shot, so we tried looking into your computer to get some answers. So far, we haven't gotten past your password."

Mitchell's eye frowned. "Password? There's no password."

Watts's turn to frown. "Loeb said he couldn't get in."

With a faint smile, Mitchell said, "He probably said something wrong and Angie went off in a huff."

"Loeb hooked her up to the city computer. Maybe it—"

"He did *what?*" Mitchell demanded, trying to rise. "Don't do that!"

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Confused, Watts asked, "Why?"

"There's no telling what she'll do. We had to compress her down to a bare minimum just to get her from the computer at home into the portable. If she gets out into a large computer, she'll—"

Anne, suddenly looking worried, turned to Watts. "When did Loeb hook up those two computers?"

Frowning, he said, "I'm not sure. Sometime this morning."

"About when the city started dying?" Anne prompted.

His eyes widening, he said, "I'm going to have Loeb's ass for this."

"What's going on?" Mitchell demanded.

Anne turned back to him. "The central computer system that runs the city started going haywire earlier today. We're slowly losing everything that's controlled through the computer . . . air, slidewalks, the works. And whatever it is has spread to New London and Besselton."

Mitchell began pushing back the covers on the bed. "We've got to get to her. She's probably frantic. Doesn't know where anything is or how to find me."

"Couldn't she just find the information in the system?" Watts asked. "Surely, your name was entered into the system when you were checked into the hospital."

"The computer here in the hospital is independent of the main system, and it's the only one that has any information," Anne pointed out.

Mitchell sighed. "Okay, let's get going."

"You're not going anywhere, Wyatt," Watts said. "In case it didn't sink in, that headache you've got is a gunshot wound. The doctor will have a conniption if you even suggest such a thing."

"Look, you said the air is out, right? How long can people survive without air?"

"Not long," Watts admitted.

"Then get a doctor. Get a nurse. Get a wheelchair or a gurney or something. Quit stalling!"

The doctor was understandably less than enthusiastic, but Mitchell's logic was undeniable. Anne left Travis at the nurse's station, and they were moving in less than ten minutes. They used an ambulance for the ride from the hospital back to the police station. Once there, they gently deposited him in a wheelchair and rolled him down the corridor to Loeb's computer lab. Loeb was nowhere to be found.

Once installed in front of his computer, Mitchell began talking. "Angie, it's me. Talk to me, honey."

"Wyatt?"

"I'm here, babe."

"Are you feeling okay? You sound a little rough."

"I wish you could see me, but we'll get into that later. Listen, I think there's a copy of you running in another computer. You're going to have to go in and get her."

"Some idiot tried to bring me up. Kept acting like I was some kind of stupid Living Home program or something. I wouldn't talk to him. Then the bastard tried to rape me. Stuck a cable up my rear end without a word of explanation, or a whispered sweet nothing, or *anything*. I'm going to get myself reincarnated into a body so I can punch him in the nose."

"Yeah, well, he's part of the story, Angie."

"I fixed him good. He tried to take me apart from the inside out, so I sent a bug back up his line."

"How big a bug; babe?"

"Part of me. Told her to blow every program in that guy's computer into next Wednesday. Made her smart enough to work around any of the usual protections." There was a scarcely detectable pause. "*Uh, oh* . . . are you telling me that my bug is the problem?"

"I think so."

"Oh, dear. Half a sec, please."

It was considerably more than half a second. In fact, it was more like three minutes, but Mitchell waited patiently,

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holding the side of his head and breathing shallowly.

Angela's voice came back. "All right. It's over. I deleted my other self."

Mitchell's weary voice asked, "What about the software that was running in there before she got loose? These people have a city to run, babe."

"City? Wyatt, it's clean in there. Nothing. Nada."

Mitchell's head dropped. The nurse and doctor both started forward, but he raised back up again. "Angie, listen to me. We've got a really serious problem, here. We're in Crisium, and their air is run through that computer. We need some air regeneration, fast. And you're telling me there's nothing left in there?"

"Nothing," she said quietly. "I'm sorry. I didn't have any way of knowing that there was a mainframe further up the line. All I knew was that someone was trying to break in, so I shot in self defense."

Anne spoke up. "Angela? Hi, my name's Anne Lister. I don't know how capable you are—I just met Wyatt half an hour ago and we haven't really had much of a chance to talk about you—but is there any way that *you* could get the air going? If it will help, I've got some old files in my computer back in my tunnel that have all the hardware addresses for things like the air system."

"Yes, ma'am. Do I have permission to upload a full copy of myself into the system?"

"I think that, under the circumstances, you'd better do exactly that."

"Yes, ma'am. I've begun. You wouldn't happen to know the hardware address to your tunnel's computer, would you? The software translation tables were wiped."

Anne smiled faintly, closed her eyes, and recited a string of digits. A few minutes passed in silence.

Mitchell said, "Angie, give me an update. I'm getting lonely here."

"I just got myself running a little over thirty seconds ago, and I'm having to do a hunt and peck search to find things. Hang on, I've got it. Um, Mrs. Lister, your computer is password-protected."

"January."

"Thanks. I'm in. Now, where do I find those files?"

Anne told her and within seconds Angela said, "I've got the fans going. The regeneration system is staging up—should be online in a few more minutes. So far, all I've done is turn everything on maximum. I'm going to need some more detailed information as to what I should be reading from the feedback—"

"The air just came back on!" came from a shout from down the corridor.

Watts leaned out into the corridor. "Check on communications."

"Not yet."

"The slidewalks?"

"I'll check."

Watts leaned back in. "Looks like it's working."

"Angie?" Mitchell said.

"I'm here."

"Thanks, babe."

"Wyatt? Who's the other man's voice I hear?"

"Oh, sorry. I'm Sam Watts. I'm the police chief here in Crisium, which is where you happen to be at the moment. Nick Loeb is the name of the fella who tried to do impolite things to you . . . one of the things I intend to bring up with him is proper manners towards a lady, whether she's flesh and blood, or otherwise."

"Wyatt . . . can we keep him? He talks nice."

"Sure thing. Listen, you might want to check on New London and Besselton. Their systems are connected to the one here in Crisium, and they might have been visited by your little doppelganger."

"I'm sending out queries . . . now. I'll have an answer one way or the other shortly," Angela said. "Oh, and something else. Um, I don't know how to put this without sounding forward, but . . .

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can I stay in here? It's big. Roomy. I could unpack and stretch out a bit."

"Honey, I don't know about that. You see, well, we're sorta guests here and—"

"Wyatt! Are you telling me you've been arrested?"

"No! Of course not!"

"Then why are we in a police station, and why are you acting funny, and why do you sound wrong? Oh, *dammit*, somebody find me some *eyes*! I can't see a thing and clearly there are things I don't know."

"It's all part of the story, Angie. It's been a little scary, but it looks like it's going to get better now. Listen, I'm tired and my head hurts and I've got a doctor here who keeps looking at his watch. I need to get back to the hospital so they can—"

"*Hospital!* Wyatt, are you all right?"

"Well . . ."

"Does the hospital have a terminal?"

"I guess."

"If you need to be in a hospital, get moving, but I want you to hook me to that terminal, and if it doesn't have eyes, somebody had better hit the spare parts bin and find me at least one . . . *fast!*"

"Rather, um, demanding, isn't she?" the doctor noted.

"How would you feel if your wife had been hurt and no one told you?" Mitchell pointed out. "You'd have a few questions, I imagine."

"Hey, don't forget I was raped, guys."

Mitchell shrugged, still looking at the doctor. "You catch my drift. She may not have gotten shot, but she's—"

"*Shot?* Who got shot? Wyatt? Are you going to be okay?"

"Unless the doctor says otherwise, I'm going to live. Probably have a scar, I guess."

Angela paused, then asked hopefully, "Will it be a dashing, sexy scar?"

The ponderous Lunar sunset was underway as Anne Lister sat staring off the side of the cliff across the bleak gray bottom of Mare Crisium. Beside her was the box containing Alan's ashes.

She had considered dividing the ashes and placing a third in each of Luna's major cities, but that was unfair to Alan himself. The indignity of being divided would reduce the importance of each repository; they would become nothing more than curiosities . . . trivialized tourist stops, with a spotlight on a small urn and a plaque identifying the contents. Alan was not going to become an exhibit under glass, dusted on Tuesdays and Thursdays, with a bored tour guide droning in a monotone about the man who had united Luna.

After agonizing for ages, she had finally decided to give Alan's ashes to Luna itself—to let him seek anonymity among the dust of the small planet that had made him such a large man. She picked up the box and held it in her lap. "I never got to tell you good-bye," she said softly, looking out towards the horizon. "Not in any way that counted. I don't know that I could have, anyway. I miss you. I'll always miss you. But, I've got to go, and I can't take you with me. You belong here."

She reached up to dab at her tears, only to hit the face plate of her helmet. They streamed down her cheeks, unimpeded.

"Dammit, Alan, I never thought I'd have to carry on without you. I thought we'd be able to tease each other walking around on canes. Now, you've gone and left me here alone."

She sighed deeply, trying to get control of her breathing. She opened the box and plunged her gloved hand into the fine gray powder inside. Impulsively, she flung the dust off the edge of the precipice, followed by another handful, and another, until there was only the dust in the corners where her gloves would not reach.

She turned the box on its side and tapped the remainder out into her hand. Kneeling, she sifted it gently across the ground at her feet. Except for the tiny white remains of his bones, it was nearly identical in color to the lunar dust.

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"Good-bye, babe," she whispered to the last few specks in her glove. "I love you."

On her way back, she thought her visor had picked up some of the dust, held by a static charge. She wiped, but it got no better. She squinted at the blurred outline of the surface structures of Crisium. Something strange, here.

After driving another kilometer, she understood.

People.

Hundreds. No . . . *thousands* of people. Outside.

Waiting.

For her.

As she neared the city, they parted to let her pass. One man saluted. Then another. And another, until every visor had a hand raised before it.

At the top of the ramp leading down into the parking garage, she stopped and got off the rover, turning back to face the people of Crisium. Every face was turned towards hers. Not wishing to speak, she knew that she had to say something. She switched to the common radio channel and, swallowing hard, said, "I've just come from burying Alan Lister. He is here, with Luna . . . and with you . . . where he belongs."

Later estimates put the number of people on the surface at nearly nine thousand—the largest number of people ever to stand on the surface of Luna at one time. Simple logistics kept the number from being higher still—the air locks could only pass so many at a time, and they were still queued inside, waiting to get out, when Anne Lister reentered the city.

She reluctantly accepted Edgar Rice's invitation to write a column for the Crisium Observer. And, as he had suggested, she used it to point out things that she thought were good and those that were bad. She was astounded to find that, though she had no official capacity or authority, many of her suggestions were quickly put into effect.

Something that she was powerless to stop was Brian Stuckey's extradition to Earth. Sympathetic juries would be easy to find; Lunarians regarded it as a foregone conclusion that he would get a light sentence on Earth. Samuel Watts was grim about it, but glad to have him gone from Crisium.

Six deaths resulted from the 'Air Panic' as it came to be known. Earth's attitude was largely one of righteous anger. Serves them right, was a common comment heard in a survey taken after the incident. Another comment that surfaced was that God had given them a warning. By the time the final numbers were tabulated, just over 37% of those asked had felt that Luna 'had it coming to them,' in the sense of divine retribution; a shot fired across the bow.

Lunarians had a different, more pragmatic view. Sales of in-tunnel air regeneration systems soared. By sheer good timing, a small company had just released its first product, a bioluminescent lighting strip that needed no electricity. Having caught the crest of the wave, they rode it to become one of the most successful first-year start-up companies in Lunar history.

Anne Lister joined a battle of her own. A personal battle. She was coming to realize that she had no place that felt like home. Luna had been a fulfilling and wonderful place to live up until the death of her husband. Now, she wanted only to get away. Earth was out of the question—to her, as to most Lunarians, it was a source of infection, of dark impulses that were best quarantined. The very earliest stages of tunneling on Mars were underway, but though she had planned to relocate there, she was coming to realize that Mars was not the answer, either. Her other alternative was still, at best, not much more than wishful thinking. No matter how she tried, there was simply no way to escape the

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fact that she was going to have to redefine her life from the inside out.

Wilbert Dinkins had been reunited with Hangdog for two hours and had yet to stop rubbing and stroking the cat. So far, Hangdog was taking the excess of attention gracefully. Wilbert looked up at Angela's hologram. "You want to rub him?"

Her image moved across the room and reached out as though to scratch his ears. Hangdog, not quite sure what to make of this person-who-did-not-smell-like-a-person, made as though to accept homage, closing his eyes and leaning into the expected pressure of her fingers.

When it did not come, he opened his eyes, only to find her fingers busily scratching away in mid-air just above his head. He reached, trying to place his ears where her fingers were, but gave up in frustration after a few moments..

"Seems that flesh and blood scores again," Angela said. "I can't quite seem to get through to Hangdog."

"Give it time," Anne Lister said. "I'm sure that Wyatt will think of something."

Mitchell, his head still bandaged, smiled. "I'll put it on my list of things to do, but it'll have to take a back seat to finding a job."

"From what I've heard, the head programmer job for the city is open," Anne suggested, as she adjusted the blanket covering Travis.

Mitchell leaned forward, elbows on his knees. "I don't know what to do, folks. After I got beat up, I panicked and ran. I never thought things through. Maybe with Stuckey in jail, I could go home."

"Is that what you really want to do?" Anne asked.

He shook his head. "I don't know. Part of me still thinks of my apartment as home. Part of me would cringe every time I came home after dark."

"*I* have a home," Angela said. "If they'll let me stay here, that is. I did manage to cause an awful lot of trouble."

"Begging your pardon, Miss," Wilbert said, "but seein' as how you're not real, I don't see how you can take the blame. Kinda seems like it would pass right through you, if you know what I mean." He passed his hand through her projected arm to demonstrate.

"Someday, I hope to be born into a human body, Wilbert," she told him. "I'd feel guilty if I had something like that hanging over me."

"They say you can be forgiven your sins," he offered quietly.

"Original sin, with a twist," Mitchell observed. "That implies that Angie has a soul."

Wilbert shrugged. "I don't know about stuff like that."

Anne had been lost in thought. Now she looked up and said, "Wyatt, why don't you sell Angela to Crisium? That would—".

"*What?*" Angela squawked.

"Hang on a second, Angie," Mitchell said. "Let's hear what she has to say."

"It would give you some income, which you're going to need, and it would also give Angela a nice home. And the city needs *something* to keep it going. So far, she's doing a fine job."

"Wyatt?" Angela prompted, a worried look on her face.

"I . . . I don't know. Anne, I wrote Angie just to keep me company—as a kind of hobby. I hadn't really considered selling her code." He shrugged. "I'm not sure that matters any more, though. Angie has written a lot of her own modules recently, and I'm sure she's modified and cleaned up a lot of the stuff I wrote. At this point, it might almost be more fair to ask her what she wants. Granted, I started her, but she's pretty much self-made now."

Wilbert had a distracted expression on his face. "Um, Mr. Mitchell, I . . . well . . . "

"It's okay, Wilbert. Go on."

"That Stuckey man who, you know, shot us, you and me . . . he thought Angela was bad, right?"

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"Yes."

"What if . . . what if she's not bad. What if she's good? Real good. Like *real* good? She's a, um . . . v-virgin, right?" He was blushing furiously.

Mitchell blinked and turned to Angela's projection. "How about it, babe? You been messing around behind my back?"

Angela shook her head. "No hanky-panky, Boss. Honest. Been saving myself for you."

"P-p-please . . . I'm s-serious," Wilbert stammered.

"In the sense that you mean it, I'm a virgin, Wilbert," she told him calmly.

Anne was chewing her lip. "Wilbert, are you saying what I think you're saying? That Angela is the Virgin Mother?"

He nodded jerkily, licking his lips nervously. "Or Jesus, hisself . . . um, herself, I mean. The Second Coming."

Angela cocked her head and regarded Mitchell. "Kinda makes you want to treat me with more respect, huh?"

"Wilbert, what you're suggesting is . . . rather serious," Mitchell said.

"Jesus, he's been telling me some stuff that don't make any sense. I don't . . . I can't make heads or tails of any of it." He looked down at the floor and mumbled, "But I'm not real smart, you know."

Mitchell glanced at Anne and Angela, and shrugged, as though to ask how to deal with what Wilbert was saying. Then he said, "Wilbert, you know I don't believe in God, right?"

Wilbert nodded, still looking at the floor. "He don't care. Said that didn't matter—that you were a good man." His head came up defiantly. "That's why I came after you . . . here. Jesus told me that you needed me, that *she* needed me."

"I'd like to stay impartial here, but he did save your life, Wyatt," Anne put in. "Left his home, his job, everything—just like you did."

Mitchell sighed and looked up at Angela. "Well? What do *you* think?"

"*Me?* I *know* who created my code. You wrote me. I'm here. That's good enough for me. We're getting into some issues that I'm not sure I'm competent to comment on. How would I know if I was some form of religious being? What would it feel like to be such a person? Wyatt, I don't even know what it feels like to be an ordinary human, much less the son or daughter of a hypothetical Christian god."

Wilbert looked apologetic. "I have to try to do what Jesus tells me, and that was to help you. Both of you. I . . . maybe I did that when I knocked over that Stuckey guy when he was going to shoot us . . . I mean, you." He reached up at rubbed at the bandage over the entry wound on his shoulder. "I shoulda bit him *twice!*"

Mitchell laughed gently. "By the way, thanks for saving my life."

"It's okay. I like helping people. Not many times I'm able to do that, you know. I'm kinda like you now, I don't know whether to stay here or go home and see if my supervisor fired me." He gave a wrinkled smile. "I don't think he likes me."

Anne said sadly, "Not one of us knows what to do next. Edgar said something to me that struck home, although it may take me a while to forgive him for speaking the truth. I had intended to move to Mars, but I'm no longer certain that's the right thing to do. Both Wyatt and Wilbert are having difficulty deciding whether to stay here or go home, and Angela, I'm sure, would like to set up shop in the city computer, but doesn't want to be left behind if Wyatt should go back to Earth."

Angela affected a sigh. "Actually, I could both stay here and go back to Earth. I can be anywhere there's a computer."

"At the same time?" Wilbert asked.

She nodded.

"You could be with me, too? At my apartment?"

She nodded.

"*See!* I told you! She's omnip . . . omnip . . . she's *everywhere!*"

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Angela looked thoughtful. "Wyatt, could we send a copy of me along with Wilbert, wherever he goes?"

Mitchell nodded. "Wilbert would you like a copy of Angela?"

And Wilbert literally fell to his knees before Wyatt, clutching Hangdog to his chest. There were tears in his eyes. "Oh, *please?* I'll take care of her. Promise. What am I *saying?* She's omni-whatever . . . she'll be watching over *me!* Oh, I don't know what to say. Yes . . . yes . . . I say yes!"

Wyatt, eyes wide at this, said, "Um, well, then I guess if it's all right with Angela, it's all right with me."

Wilbert held Hangdog at arm's length. "Did you hear that? She's coming with us!"

"Now, all you have to do is figure out where you're going," Anne pointed out.

"Home. I'm going home. Angela can tell me if she needs me or if Mr. Mitchell needs me. Then I'll get on the bus. Right then." He got up and sat back in his seat with the satisfied air of a man who has made a decision.

Anne shook her head. "Well, that leaves you and me . . . and Angela, of course."

"Wyatt, sell a copy of me to Crisium. If I can be with Wilbert and you at the same time, I might as well watch over Crisium, as well," Angela said. "If I trade around my memories among the various copies, then it will be just like I was there in the first place." She smirked, "Finally . . . something I can do that humans can't—virtual telepathy."

"Are you sure you're comfortable doing this?" he asked.

Her image nodded. "What Anne said made sense. You'll need the money. And I can still be with you, wherever you go." She grubbed her hands together. "Charge 'em a high price, buster. We've got 'em over a barrel. If they balk, I'll start turning the lights out." She stopped, then asked, "You *are* taking me with you, aren't you, Wyatt?"

Mitchell smiled. "Always, babe. I guess we'll go home, too. If nothing else, we'll have to show up for the trial."

"And that leaves me," Anne said. "Oh, hell, I guess I'll stay here in Crisium. At least for a while. Angela's going to need someone to teach her the secrets of the city, and it's a cinch that the Commissioner isn't going to be the one to do it. That way, when it's time to leave, I can rest easy, knowing that the city's in good hands."

Angela turned to her. "Anne, I can't claim that I'll do as good a job as you and your husband did, but if you'll teach me how, I'll do my dead level best to keep things on an even keel."

Anne had a faraway look on her face. "Maybe we should start by reviewing all the decisions that Alan made. Maybe you can figure out how he did what he did. I've left his ashes here. If we can teach you to think like him, then perhaps I can leave a bit of his essence . . . his soul . . . here, too." ■

Editor's Note: The events in "Ashes to Ashes" take place shortly after those in Darwin's Children (December, 1993), "Survival of the Fittest" (May, 1994), "The Missing Link" (October, 1994), and "Evolution" (December, 1994).

The brain of a dinosaur was only about the size of a nut, and some think that is why they became extinct. That can't be the reason though, for I know plenty of animals who get by with less.

— Will Cuppy

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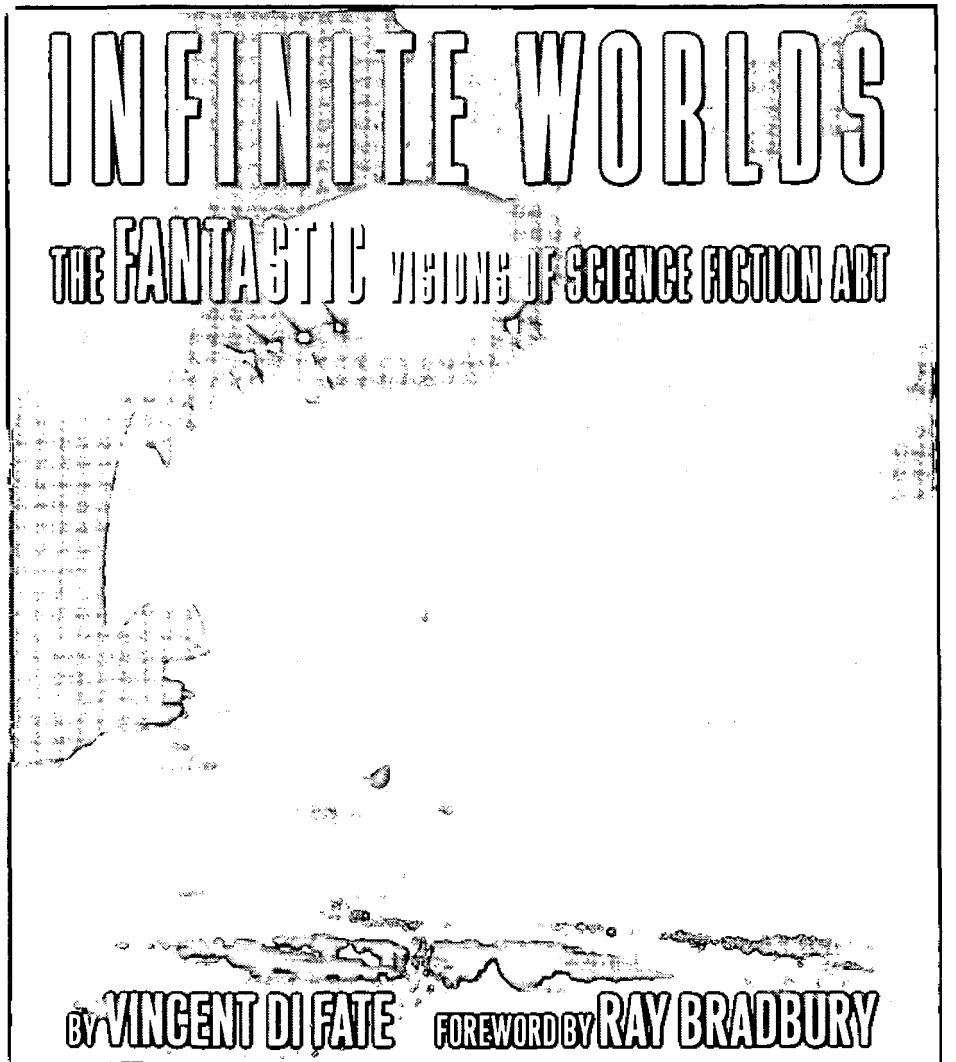

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The Blood Jaguar, Michael H. Payne, TOR, $22.95, 256 pp. (ISBN: 0-312-86783-2).
Heaven's Reach, David Brin, Bantam, $24.95, 449 pp. (ISBN: 0-553-10174-9).
Dreaming in Smoke, Tricia Sullivan, Bantam, $5.99, 405 pp. (ISBN: 0-553-57703-4).
Stinger, Nancy Kress, TOR, $24.95, 304 pp. (ISBN: 0-312-86536-8).
Steeldriver, Don DeBrandt, Ace, $5.99, 330 pp. (ISBN: 0-441-00520-9).
Heartfire, Orson Scott Card, TOR, $24.95, 301 pp. (ISBN: 0-312-85054-9).
Reckoning Infinity, John E. Stith, TOR, $23.95, 282 pp. (ISBN: 0-312-86298-9).

Once upon a time, Michael H. Payne tells us, thousands and thousands of generations ago, everyone lived in the sky. Then they decided to build a world and chose a Curia—a Lord and Lady from each type of folk—to run the project. When they were done, the Curials began to argue over whether they should remain in charge or disband and give up their powers. In the end there remained a dozen Curials, with a thirteenth, Lady Jaguar, as a goddess of death.

Lady Jaguar? The others are Lion, Leopard, Tiger, Dolphin, Raven, Kit Fox, Eft, and so on. And the types of folk are hardly human, but badger, skink, and meerkat, rabbit, squirrel, and otter, critters all. **The Blood Jaguar** is thus a mythic story, redolent of children's tales and Native American myths (the skinks have kivas), among others.

Many fantasies of this general sort are insufferably cute. Payne avoids that judgment by deft use of irony: His hero, Bobcat, is a catnip junky, a ne'er-do-well who loves to chase the local bunnies to exhaustion until he runs up against a clever bunny maid, one Garson Rix (a field supervisor at Brackens Farms), who thoroughly outsmarts him. Now they're sweeties, but Bobcat doesn't have much time to pursue that issue. Skink has lost his luck and told him that when a skink loses his luck, the nearest Bobcat had better watch out, for the worst possible fate awaits.

Hah, thinks Bobcat. You mean the catnip crop will fail? But no, for as he sets off to do some mischief, a fiery cloud appears, all eyes and terror, pitches him into a bramble patch, and settles into his heart to stay. That's the Blood Jaguar.

Whoa, says Bobcat. Back to Skink, who says they must go see Fisher, the local shaman. Soon they have uncovered dim memories of a previous skink-bobcat-fisher expedition that had many years ago set off on a quest to prevent disaster and failed, for it was followed by the Plague Year, when half of all living things died.

Whoa again! You mean . . . ? And that's our job too?

Off they go a-questing. The first part of the job is to figure out exactly what is going on, which means a visit to the desert city of the meerkats. There they learn something of the history of the world and that skink-bobcat-fisher

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quests and Plague Years are recurring events, perhaps designed by the Curials to prevent population explosions. Yet still their path lies ahead, Lady Jaguar awaits, and Bobcat's hopeless job is somehow to persuade her to spare the world, his friends, his sweety. His predecessors have chosen to fight it out, to try to slay Death with tooth and claw. They failed.

What can Bobcat do? Must he abide by the traditional script? Or is there a way out of the bind?

Poor Bobcat. All that catnip has had a lasting effect on his faculties, but he hasn't touched it for ever so long. He's trying, he is, for his bunny's sake, and in the end indeed the ne'er-do-well becomes a do-well. *The Blood Jaguar* is a classic tale of redemption done up in a very appealing form. I enjoyed it greatly.

The last book of David Brin's latest Uplift trilogy is now out, and it's well worth the wait. Rush right out and grab a copy. You'll be glad you did, for Brin is an imaginative treat.

Following *Brightness Reef* (reviewed here in February 1996) and *Infinity's Shore* (reviewed March 1997), **Heaven's Reach** picks up the story immediately after the flight of the *Streaker* from Jijo (a world officially fallowed to let its biosphere recover from the ravages of civilization). The *Streaker*—still crewed by humans, chimps, and dolphins from Earth—is now carrying several representatives of the Jijoan sooner species (illegal settlers) and leading a fleet of reactivated hulks those settlers had abandoned many generations ago at the bottom of Jijo's sea. It is pursued by a dreadnaught of the Jophurs, pirate Nazi donut-stacks all afroth to seize the *Streaker* and its tradition-defying secrets (the coordinates of an ancient fleet) and capture the rogue Earthlings and the Jijoan settlers—one species of which they aim to exterminate.

The book's opening scene looks quite hopeless. But wait! Here are the hydrogen-breathing Zang and hints of strange symbiotic mergings among very different life-forms. Here are sudden alliances, sudden shifts, crumbling Fractal worlds (like Dyson spheres), the appearance of the Harrower to pluck ships—including *Streaker*—from the spaceways. Here is a neutron star surrounded by massive gateways, elder races shepherding those Harrowed ships through the gates as candidates for Transcendence, cosm-quakes as the universe adjusts its expanding fabric, sudden chaos, deaths of trillions, and *Streaker* finally on its way back to Earth, where a vicious siege is reportedly about to end with the final destruction of everything that Earthlings hold dear—notably including their independence from patron elders who will indenture them for a hundred thousand years, deny them the right to uplift others as they already have (those chimps and dolphins), and even take control of their own further evolution.

As trilogies are wont to do, this one ends in triumph. Characters go off about their business, with at least one—puckish Alvin, a hoon from Jijo—well set to reform his dour cousins of other worlds to gaiety.

And Brin assures us in his afterword that there is more to come. His Uplift universe is far too rich to drop at this point.

I'm looking forward to what Brin comes up with next.

Tricia Sullivan's **Dreaming in Smoke** is a portrait of a space colony gone desperately wrong. Years before, Earth's probes had shown that the world of T'nane had life and oxygen. Heigh-ho, then, and off the colony goes with an artificially intelligent computer named Ganesh, the colonists in suspended animation, and an ample supply of embryos. On arrival, the life—of a sort—proves to be there, but not the oxygen. T'nane is a world that swarms with primitive lifeforms similar to bacteria

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and blue-green algae, powered by intense outpourings of volcanic heat, given to rapid exchanges of genetic material, constantly adapting.

The volcanic outpourings prove an ample power supply for the colony. The ship is dismantled and turned into a base. A byproduct of the local organisms, luma, proves useful as a structural material which Ganesh can use for information storage and processing. Researchers aggressively attack the "Oxygen Problem," but when one team succumbs to a local infection, the effort halts. Except—one man, Azamat Marcsson, remains from that team, and he *will* not quit. Earthborn, stubborn, never much of an achiever, he dreams of solving the Oxygen Problem and making the colony able to thrive as planned. His approach is to search the data inside Ganesh as a Dreamer (think of virtual reality and cyberspace), protected by a "shotgun," another Dreamer who watches out for and wards off any possible trouble.

The trouble is that Azamat is a colorless fellow, and when he Dreams, his virtual reality is placid and boring. His shotgun, young, unmotivated, lackadaisical Kalypso Deed, is thus caught very much by surprise when he goes berserk and the system crashes.

The colony's survival depends utterly on a functioning Ganesh. Without that, the colonists must evacuate to a smaller secondary base. Meanwhile, Kalypso must find Azamat and deliver him to the colony's "witch doctors" (programmers) so they can figure out what he did wrong. Unfortunately, Azamat is elusive, and the best Kalypso can finally do is pursue him into exile outside the base.

Now Sullivan tells us that those Oxygen Problem researchers are not dead after all. They have found ways to survive outside the colony, and they have an agenda of their own that may or may not include the survival of the rest of the colony. The second half of the book explores the ramifications of this, puts Kalypso through torments that are unfortunately only palely realized, and comes to an opening of potentials that is a satisfactory resolution.

I suspect this one would not appeal to readers unaccustomed to SF, or accustomed only to what passes for SF on TV and film. Hardened SF readers, on the other hand, should enjoy it.

Nancy Kress calls her new novel, **Stinger**, "a contemporary-FBI SF novel for people who don't ordinarily read SF novels." She's dead wrong, for people who *do* read SF will love this one. She's also absolutely right, for *Stinger* is a police procedural medical catastrophe terrorist conspiracy tale that should appeal to a great many people.

Opening scene: dead of night, mystery car whizzing through the Maryland swampland, leaping deer, crash, and *something* escapes from cages in the back of the car.

Scene two: Hot new presidential candidate Malcolm Peter Reading keels over on stage, dead of a stroke. Soon the medics are puzzling over strangeness in his blood, a new kind of malaria. Funny thing, the "malaria reading" parasites preferentially attack red blood cells that carry sickle cell hemoglobin and cause them to clog blood vessels in the brain. The sickle cell anemia gene is carried by many blacks and some Indian emigrés, and it *protects* against normal malaria.

"Tragic mutation," pronounce many of the experts from the Centers for Disease Control (CDC) and elsewhere as they scour the Maryland countryside, tracking down the epicenter of the epidemic and bringing in military mosquito-control techniques.

"Attempted genocide," cries dedicated CDC epidemiologist Melanie Anderson. Too many altered genes. Too damned targeted. Of course, she's black, she's female, she's hysterical. Nobody pays much attention. Yet.

Enter Robert Cavanaugh, whom we last met in Kress's excellent *Oaths and*

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Miracles (reviewed here in August 1996). He's still cozy with science writer Judy Kozinski, though she's pushing him to regularize their relationship and he's resisting. Life is complicated, and when he gets a call from a nurse suspiciously concerned about a rash of black stroke victims at a southern Maryland hospital, it gets more so. Soon he's part of the malaria reading team, part of the FBI squad that arrests the wrong suspect (shades of Atlanta bombs), and one of the few with doubts about what is really going on. Soon thereafter he's watching his boss get promoted off the case, the CDC chief investigator get promoted to Geneva, himself get suspended off the case for a very minor infraction, and Melanie get sidelined too. Something funny is going on, some independent, objective investigation seems to be in order, and he and Melanie are hot on the trail of a cover-up that involves the CDC, the FBI, the CIA, and Maryland's Fort Detrick, which once upon a time was where the US government developed both biowar weapons and the defenses against them.

Scary stuff, and Kress has a host of quotes to tell you that a great many authoritative figures think that biowar is inevitable. She's right. It's coming. It's likely to be much subtler and more precisely targeted than the anthrax we hear about in connection with Iraq and midwestern cranks. And it would be quite sweet of the Fates to let it introduce itself as diffidently as it does in this novel. The truth will surely be much nastier.

Don DeBrandt's second novel, **Steeldriver**, should delight *Analog* readers and fans of Mike Resnick. DeBrandt has taken the myth of John Henry, the steel-drivin' man who went up against the machine and blew his heart out, and turned it into the tale of Jon Hundred, an eight-foot-tall cyborg on the run from his corporate owner, hiding out on the world of Pellay, where a mountain blocks the line between mines and spaceport. On one side of the mountain, the AI Mel runs the mines and operates tunneling machinery chewing a hole through the mountain. On the other side, human and Toolie (alien) laborers use obsolete machinery to chew toward Mel. Jon is the Big Man among the laborers—nobody bigger, nobody stronger—and when the tunnel caves in, he's the one who drives the obsolete equipment harder than it has ever been driven to reach the two survivors just in time.

Sounds like there ought to be a song about Big Jon, eh? Oh, there will be, certainly on Pellay when folks have recovered from the impact of events, and surely at SF cons as soon as the filkers read this one.

But this is more than the John Henry tale cast into the future. Jon Hundred is a driven man, consumed by grief for the damage he was obliged to do with his neutronium Hammer before he escaped his masters. He loves his fellows, takes delight in their love of him, and knows full well that one day he will be found.

That day comes all too soon, for a strange man named Hone appears at the mines, claiming to have survived a spaceship crash. He speaks briefly with Jon Hundred on the viewphone, and both know what must happen as soon as the tunnel is finished and they meet, when Jon Hundred must once more take his Hammer in his hand.

Meanwhile there are friendships with Toolies and tourists, a wager and a bond between Mel and Jon, the revelation that the technology of the time can program a mind as if it were a computer, and the discovery of Hone's sympathy and pain. The tale is more complex than the John Henry myth, for that focused on the win-lose competition between human and machine, the honor of the doomed struggle against the inevitable. That is here too, but there is as well the recognition that competitors can be friends, that humans and machines can be allies, that the struggle is to escape the bonds

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of the machine.

Yet there is also the recognition that it is not really the machine that binds us. Again and again, Debrandt insists, "The job's okay—it's the bosses that make it hell." Not the machines, but the people who use them with no thought of humanity.

Recommended.

Orson Scott Card's *Tales of Alvin Maker* series has earned great praise here and elsewhere. Part of the appeal lies in Card's superlative skills as a storyteller. Part lies in the world he has created, an alternate frontier America, where history differs and Appalachian-style magic works. Notably, many people wield knacks—more than mere talents—that make work simpler and easier. Alvin Maker, the seventh son of a seventh son, has the knack of shaping stone and iron by his will alone. His implacable foe is the Unmaker (read: Satan) and its minions, the forces of erosion, entropy, and chaos. And through four books now, he has grown and triumphed and struggled toward a dream of building the Crystal City, the City of God, whose citizens will all be Makers much like Alvin. The last book, *Alvin Journeyman* (reviewed here in January 1996), focused on Alvin's brother Calvin—dearly beloved but warped by envy, an unwitting servant of the Unmaker; it ended with a hint of future reconciliation.

That reconciliation may or may not be found at the end of **Heartfire**. Card hints but is not explicit, giving us process more than result. He begins in Philadelphia, where Arthur Stuart, the black boy whose very genes Alvin had to alter to protect him from the slave finders, has found fascination in the window of a taxidermy shop. Soon Arthur is hunting down John James Audubon to berate him for killing birds just so he can paint them and then to persuade a goose to pose, alive. Soon Audubon has joined Alvin, Arthur, Mike Fink, and English lawyer Verily Cooper for a trip to Massachusetts, where Alvin hopes to learn the secret of governing a City of God but instead falls prey to the charge of witchery (New Englanders consider knacks signs of allegiance to Satan). If Verily cannot get him off, he will hang. So will Purity, the orphan daughter of a couple hanged at her birth. I only hint at the complications when I reveal that Purity is the one who charged Alvin and his friends with witchcraft, and Verily is just a tad besmitten by her.

Meanwhile, Alvin's pregnant wife Margaret has gone to the Crown Colonies to try to talk the king into abolishing slavery in hope of preventing war. Peggy is a torch, who can see into anyone's heartfire (akin to soul); she is astonished to realize that the docile slaves of Camelot have very dim heartfires, lack names, and feel no rage at their plight.

Calvin is there too, with his friend Honoré de Balzac, goofing off, looking for mischief. He learns that Peggy is in town and arranges to meet her. He also discovers something strange down on the docks: as newly arrived blacks descend the slave-ships' gangplanks, they hand little scraps of cloth and wire to a man with a bucket of water. As they do so, their heartfires dim; they lose both name and outrage. This is a clear comment on the way people, in order to tolerate the intolerable, must submerge themselves, deny their hearts.

When Calvin uses his doodlebug (call it an astral projection) to follow the man with the bucket, his heartfire is trapped in a web of charms and hexes. Balzac takes the mindless zombie body to Peggy, who pretty promptly finds the web and visits its master, Gullah Joe, a master of African magics.

That's when the kettle gets kicked over, the slaves grow restless, the king gets mad, and Calvin tries desperately to redeem himself even though his mindless body is rotting by the moment.

Meanwhile, back in New England,

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Alvin is getting out of his jam thanks to Verily, a local scholar laboring under a major burden of guilt, and a judge—John Adams—who doesn't much like the witchcraft laws. As soon as he can, he is off, Arthur running beside him, heading for the South to pull whatever chestnuts he can out of the fire.

For Alvin, that's not really much of a problem. Soon enough, everyone is back in Philadelphia, and the crew that will build the Crystal City has gained several recruits.

Tune in next time, when Alvin apparently will visit the Tennizy town called Crystal City. Knowing Card, that town will surely turn out to be something less than a City of God; perhaps Alvin will change it.

I can hardly wait to see it. When the *Alvin Maker* series began, it was fresh and marvelous. It doesn't have that claim on us now, but each installment remains a worthy, satisfying effort. I don't expect that to change.

I missed the hardbound when it appeared last year, but now the paperback is in the stores and I can tell you that if you like stories in which intrepid explorers face strange problems in strange settings, you'll like John E. Stith's latest, **Reckoning Infinity**.

The situation is simple enough. The *Ranger*, a research ship at work near Pluto, spots a strange body barreling toward Earth. It's 100 kilometers wide, its density is low, and there are strange objects on its surface. When half a dozen crewfolk are set down to investigate, they find the wreckage of a crashed probe, a surface that seems oddly organic in texture, and a hole plunging toward the center of what is immediately dubbed "Canteloupe." Naturally enough the damned fools dive into the hole, find another probe at its bottom, jiggle it, and trigger changes that look like bleeding and healing. Now they're trapped; the only way they can go is downward, inward, exploring this vast object that is now obviously organic, even alive, and wondering how the devil they will get out again.

Interest is added by the characters. Karl was the pilot on the shuttle that crashed into the Tokyan space station and injured Alis Nussem so badly that she needed bionic eyes, heart, kidney, and legs. A court agreed he was not the cause of the accident, but most folks remain skeptical and treat him as a pariah. Alis is quite sure he's the irresponsible SOB who turned her into a half-machine and robbed her of her humanity. And when she joins the *Ranger* and finds Karl already there, things are a bit tense. Fortunately, Karl is mature enough to stay on task despite all the flak he takes. He's also really a pretty nice guy, Alis begins to see, which means . . .

Meanwhile, Earthside orbit-trackers have decided Canteloupe is dead on for a space station and is sending out a crew with some major explosives to revise the stranger's path. Alis and Karl and the rest of their crew are still deep inside, marveling at features that suggest the whole thing was built or designed, as well as at others that say it grew. They're heading for the very center, hoping against hope to find a control room, or at least a digestive system they can tickle into expelling them. They don't find that, but they do discover . . .

Suffice it to say that the goal is worth the journey. As always, Stith's imagination is worth a visit. ■

There are no days in life so memorable as those which vibrated to some stroke of the imagination.

— Ralph Waldo Emerson

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BRASS TACKS

Dear *Analog*,

When I began writing over ten years ago, it never really seemed likely to me that I'd get anything published. I was writing for the fun of it, and to make a little pocket change if anyone was silly enough to pay me for my scribblings.

As it happens, Stan has been kind enough (read: silly) to take more than one of my stories over the years, and for this I am eternally grateful. However, a new dimension has been added to my writing, one that was so far-fetched when I began that I didn't even consider it possible. On May 2nd, I was honored to recieve an Anlab for my novellette "Trail by Ordeal."

For all those who have stuck with me for the last ten years, and especially those who voted for the story . . . thanks.

GREY ROLLINS

Dear Dr. Schmidt,

Thanks for printing the letter from Sheldon Steuer in the April 1998 Brass Tacks. I'm glad to be informed that I'm not the only one who's irritated by the use of the words "they" and "their" as common gender singular pronouns. In recent years, I've read this usage so often, that I'm probably guilty of it myself. But, as you wrote in your answer to Sheldon Steuer's letter, ". . . the rules of grammar have been changing continuously. . . ."

The fact that these changes irritate me may be attributable to my age (only sixty-three, but maybe that's old enough). It is said that one becomes increasingly intolerant of changes as one becomes older. Well, similar changes, which I find equally irritating, have been occurring in the German language. How about "Die Information in dem Memory wird upgedated"? That's just a sample of some of the garbage that I have to translate into English! Or is it really garbage? Perhaps these changes ought to be recognized as cultural enrichment or something!

DON BRADLEY

Dear Dr. Schmidt,

Is Sheldon Steuer really, really "the only complaint [you've] had about this particular use of 'they'?" as third person singular indefinite personal pronoun, supplanting the previously accepted, all-purpose "he." Well, here's mine, too! Your objectively impartial approach invites readers to speak out, so I want to do my part herewith. Acceptable to whom in society? Let it be to me, if not thou! To me, using "they" as impersonal singular is a ghastly barbarism that impugns any literal taste for language by subordinating language itself to a transient political fad. That is, I know, "PC." But, but, but—look at the trade-offs: to avoid coloring impersonality with maleness and permit attributing femaleness to non-personhood, the PC agitators here forsake clarity of number. Number is objective fact, while attributions are arbitrary choices. Should science-oriented publications across the board subordinate the latter to the former? I think not. It's time to make a stand against the lazy feminists who long ago left the hard and serious

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problems of dignifying women by the wayside in favor of correcting speech, or rather carping about it—which is so much easier and less dignified a thing to do. This issue has burned me up increasingly as time goes by. There you are. Here's number two!!

JOSEPH E. QUITTNER
JF366@Cleveland.freenet.edu

Dr. Schmidt,

In his letter in the April issue, W.A. Thomasson, PhD, compares our advising posterity on the ethical issues surrounding human cloning to our forebears advising us on the ethical issues concerning chicken farming. "They could not possibly have foreseen factory farming," he claims, "where most of today's ethical issues lie. Could we do any better? I doubt it." To this line of reasoning I raise three objections.

1. I believe that—at least since the beginning of this century—if anyone had examined the situation deeply enough, they *could* have foreseen factory chicken farming.

2. Even if they couldn't have, can *we* do any better? Yes, we can. Our understanding of how science and technology develop is so much greater than it was even a hundred years ago that there can be no real comparison between the two times. Many of the potentially negative effects of technology had not yet been experienced then, whereas today we have the advantage of being able to learn from our past mistakes (which is definitely not to say that we always *do* this, but that to a certain extent we could if we tried). Road maps have been drawn—rough and inaccurate ones, to be sure, but road maps nonetheless. *Some* sort of guidelines can now be constructed in an attempt to avert possible future mistakes.

To put this more plainly: even if the idea of factory chicken farming was unforeseeable to our predecessors, the directions in which human cloning might go are not *completely* unforeseeable to us.

3. My last point is that even if I am wrong on the first two, so what? We at least *think* we have some idea what effect today's technological changes may have on future society. Does this not place upon us an ethical obligation to try to prepare that society for those effects? Many people have many different views on the implications of human cloning. Most of them will be completely wrong, and probably none of them will be exactly right. But somewhere in there, someone just might hit upon something. It might be a scientist on the cutting edge of genetic research; it might be an ethicist from a world renowned university; it might be a science fiction writer who has made a career of contemplating these types of things; or it might even be a teenaged burger-flipper or a middle-aged sales clerk who, while pondering a story by such an author or a newspaper article about such a scientist or ethicist, by luck or chance or pure intuition stumbles upon something.

Or it might not happen at all, and maybe the future does indeed sneak up and smack us right in the face. *It doesn't matter!* If we start thinking about these things now, then when technology reaches the point where true ethical issues come into question (if we are not at that point already), there will be at least something, some at least semi-organized body of thought, which those who will be forced to make the tough decisions can fall back on (or completely reject, whichever might be most appropriate).

From our historical vantage point, we possess a view unique to the annals of mankind: we can picture a future which is *different* from the present, *and* we see that that future might not necessarily be better than the present. It is our responsibility to try to make it better. Even if we cannot foresee the future, we are ethically bound to try to prepare for it, for we are the ones creating it.

EARL R. BIRINGER, JR.

P.S. One more short note, concerning

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Dr. Thomasson's choice of analogy: Can we really compare human cloning with chicken farming as it existed a hundred years ago? Had anyone yet conceived the notion of "animal rights" at that time? The concept of human rights has, on the other hand, been around for quite a while.

Dear Dr. Schmidt,

Mr. Bruce's letter in the April 1998 *Analog* has me baffled. First he says that government regulation is bad, doesn't work, destroys freedom. Then he says that "deregulation" will be bad, won't work, and will be more expensive.

I don't get it. If government regulation is bad, and government deregulation is bad, I'm forced to conclude that Mr. Bruce is really opposed to anything with the word "government" in it.

If either of you can shed some light on this I'd be intellectually enlightened.

DAVID WOLFF
dwolff@world.std.com

Dear Dr. Schmidt:

I have had a 1.6 gal/flush toilet for about ten years. This toilet replaced a 6 gal/flush toilet that had clogged once a week for about ten years, probably because of a poor fitting.

The new toilet has never, repeat never, either clogged or failed the first flush. It is a stored-pressure type rather than the gravity type that will never work.

The law, as with many "If I build it they will come" type of law, set a goal without any idea that the goal was feasible. Since the law did not require that the toilet actually work, only that it did not use more than 1.6 gallons, that is what the market got.

If I had my druthers, I would declare the gravity type a sanitation hazard.

WALTER E. WALLIS
unclegene@msn.com

Dear Dr. Schmidt,

I read with interest your April '98 Editorial. I don't think new metaphors can sufficiently address the problem—the crux of which lies in that, not *some*, but many doctors give in to their patient's demands for immediate "feel good" medicine by inappropriately prescribing antibiotics. Why? Though some doctors may be so venal as to hold on to clientele at any cost, I think it more likely that in most cases antibiotics are inappropriately prescribed because, ironically, they still do work—as placebos!

This is still an inappropriate use of them. But in our country where it has become politically expedient to enforce the notion that public and private health are very different venues, it may be too much to hope that any style of argument can significantly change this matter. I don't believe placing the onus on the patient's acceptance of this or that argument is the answer. It should rest squarely with the medical profession's enforcement of the ethics of drug prescription, both of antibiotics and placebos.

BRUCE ARTHUR GLAZER

Dear Brass Tacks:

I'd like to add one note to Stanley Schmidt's April editorial on the war with bacteria: Simple soap and water have saved as many lives as modern "miracle drugs" like antibiotics. They have more to do with the prevention of epidemics than do vaccines. And while the casual use of antibiotics does contribute to the spread of antibiotic resistance, we can lay the blame for the developement of highly virulent, multiply resistant strains, right at the feet of the medical community itself: The failure to maintain proper asepsis has turned hospitals into laboratories for the accelerated evolution of pathogenic bacteria!

Lister would be horrified if he walked into a modern hospital. Carpeted floors. No smell of antiseptics. People allowed to walk in off the street without being required to do so much as wash their hands. And the germs

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they carry out are more likely to be dangerous than the germs they carry in; if you stay in a hospital for more than a few days, you're more likely to die of something you caught there, than of what put you in the hospital in the first place! That can only mean pathogens are being transmitted within the hospital itself. What conceivable excuse for that can there be in an institution specifically intended for dealing with contagious diseases? We've known for over a hundred years how to prevent the transmission of pathogens from one person to another!

There are good reasons, based on evolutionary theory, to believe that by impeding the transmission of pathogens within hospitals, we will actually reduce their virulence; killing your host when a new host is beyond reach is *not* a survival trait! Resuming the military analogy, bacteria don't have radios; a bacterium which "learns" how to defeat a given antibiotic can't transmit that "knowlege" to another without nearly direct contact. Prevent the transmission of bacteria from patient to patient, and you prevent the transmission of resistance, and the accumulation of multiple resistances in single strains. Finally, proper asepsis prevents the infection of previously uninfected patients, in keeping with the medical dictum: First, do no harm.

In short, let's put less effort into making hospitals comfortable for people, and more effort into making them uncomfortable for micro-organisms. Antibiotics can be wonderfully effective, but they're no substitute for antiseptics!

Brett P. Bellmore
8734 Burt Rd.
Capac, MI 48014
(810)724-5924 home
(810)798-3922-265 work

Dear Dr. Schmidt,

In reference to your recent editorial on antibiotics. There is one issue that is never mentioned by the medical profession—antibiotics as they are now constituted have a shotgun effect—they kill (or try to kill) all bacteria, not just those causing a specific illness. This means that all beneficial bacteria inhabiting the body are also killed, leaving an opportunistic ecological gap that other species inhabiting the body will take over. One such species is the fungus commonly known as Candida.

I personally have had experience with Candida, and its effects can be devastating. Unfortunately again, most medical doctors still do not recognize that this condition can and does occur, and I was most fortunate that I eventually found a medical doctor who did do so and gave me the necessary treatment.

My illness and the necessary treatment took over three years before the Candida was brought back under control. I then moved to China (where I am today) and there had an attack of tonsillitis (at sixty years of age!) which resulted in massive dosing of antibiotics, and again allowed the Candida to flare up. Fortunately, I now know what to do about the disease and am treating it.

But please, do not allow anyone to overlook the effects of antibiotics on those internal bacteria that are essential to normal functioning of the body.

As an aside, I have been reading *Astounding* and *Analog* since 1947 when as a young boy of eleven, I found a copy in a newsstand in Sydney, Australia. If I remember correctly, I discovered the benefit of subscription when I was fourteen and have had an almost continuous subscription since then. And this is the first time I have written to the magazine.

Thank you for giving me my monthly dose of mental stimulation!

Trevor D. Ford
trevorford@usa.net
sztford@public.szptt.net.cn

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Dear *Analog*,

It will probably not surprise you, now that your web site for Analog is running so well, to receive an inquiry about placing the Analytical Laboratory on the web. I realize expense would be involved, so this might not be an easy decision to make. A relatively simple way to provide Anlab feedback would be with a simple online form, whose emailed results could be processed by a program written in Access, for example.

It would be easier for some of us to enter our Anlab values after each issue, rather than once a year.

Congratulations on resolving the dispute over printing the title of the story and the name of the author, by omitting the name of the magazine. What a fine solution! I had been carefully writing whatever was missing on the bottoms of pages.

TOM HANSON
Columbus, Ohio

We probably will put the AnLab on the Web in some form, when the time comes. However, it will almost certainly remain once a year for the entire year, rather than after every issue. We're looking for your preferences within the entire year, and you can't know those until you've seen the entire year. However, you could certainly do what my wife does to make it easier to know your preferences: Keep a running record in which you assign subjective scores to the stories within each issue, and then let your computer rank them at the end of the year.

As you may have noticed by now, with the new format beginning in June, we've found a way to include all the information anyone has requested on each pair of pages.

Dear Stan,

Thought some of the readers might be interested in *Mind's Eye Fiction*. It's an on-line "magazine of short fiction from multiple genres. In the case of *Analog* readers, however, *MEF* has reprints of a couple of ANLab winners currently available (including my own "Living It is the Best Revenge," Bud Webster's "The Three Labors of Bubba," and Michael A. Burstein's "TeleAbsence"). While I know most every *Analog* reader saw these stories when they first came out, some of the newer readers might not have had a chance to see these (and others like Rob Chilson's "Teddy"). *MEF* now gives them the chance to see these stories on a "pay-per-view" basis (in my own case, "Living it . . ." is available for 16 cents). The URL for *MEF* is http://tale.com.

IAN RANDAL STROCK
http://www.erols.com/irs0 ■

When you get right down to it, all the "laws" of modern science are whopping big guesses. But they are educated guesses.

— P. E. I Bonewits

Attacks upon legends are always interesting. The iconoclast need not be right, but he always offers new material.

— C. W. Ceram

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UPCOMING EVENTS Anthony Lewis

2-4 October 1998
ARCHON 22 (Illinois SF conference) at Holiday Inn and Gateway Center, Collinsville, IL. Guest of Honor—James P. Hogan; Fan Guests of Honor—John Novak and Craig Ware; Gaming Guest of Honor—Lester Smith; TM—Glen Cook. Registration—$25 until 9/31/98, $30 at the door, children 6-10—$7, young adult 11-16—$15. Info—Archon 22, PO Box 8387, Chesterfield, MO 63132-8387; 314-326-3026; e-mail—zellich@il.net

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2-4 October 1998
VIABLE PARADISE II (Cape and Islands SF conference) at Oak Bluffs, Martha's Vineyard, MA. Guest of Honor—Lawrence Watt-Evans; Artist Guest of Honor—Jael; Fan Guests of Honor—Patrick & Teresa Nielsen Hayden. Registration—$25 until 8/15/98; $40 at the door. Info—Martha's Vineyard Science Fiction Association, General Delivery, Oak Bluffs, MA 02557; e-mail—paradise@rmontor.tiac.net

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9-11 October 1998
*CON*STELLATION XVII: HYDRA* (northern Alabama SF conference) at Huntsville, AL. Artist Guest of Honor—Bob Eggleton; Fan Guest of Honor—David O. Miller; MC—Tim Powers. Info—Con*stellation XVII: Hydra, PO Box 4857, Huntsville AL 35815-4857; e-mail—constell@advicom.net

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9-11 October 1998
ALBACON '98 (Albany area SF conference) at Ramada Inn, Schenectady, NY. Guest of Honor—Esther M. Friesner; Artist Guest of Honor—Jael; Fan Guest of Honor—Joe Mayhew. Registration—$28 until 22 September 1998, $40 at the door. Info—Albacon '98, Box 2085, Albany, NY 12220-0085. e-mail—rothman@sff.net; URL—http://www.sff.net/people/rothman/albacon.htp

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16-18 October 1998
CONCLAVE 23 (Michigan SF conference) at Holiday Inn, South Convention Center, Lansing, MI 48911; Professional Guest of Honor—Esther M. Friesner. Registration—$25.00 until 9/17/98, $30.00 after. Info—Conclave 21, PO Box 2915, Ann Arbor, MI 48106; 313-454-1554; e-mail—Conclave@hamjudo.com

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29 October-1 November 1998
WORLD FANTASY CONVENTION at Doubletree Hotel, Monterey, CA. Special Guest—Frank M. Robinson; TM—Richard A. Lupoff. Registration—$125/£80. Info—WFC98, 555 Bryant Street #552, Palo Alto, CA 94301.

2-6 September
1999 AUSSIECON THREE (57th World Science Fiction Convention) at World Congress Centre, Melbourne, Australia. Guests of Honour—George Turner (in memoriam), Gregory Benford, Bruce Gillespie. Registration—$155 (A$200); supporting $35 (A$45). Info—Aussiecon Three, GPO Box 1212K, Melbourne VIC 3001, Australia. US Agent—PO Box 266, Prospect Heights, IL 60070-0266. URL—http://www.aussiecon3.worldcon.org■

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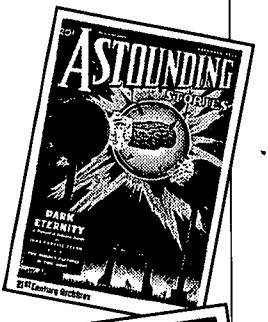

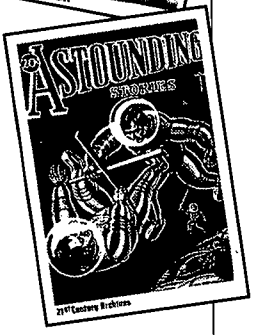

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TECHNOLOGY UPDATE

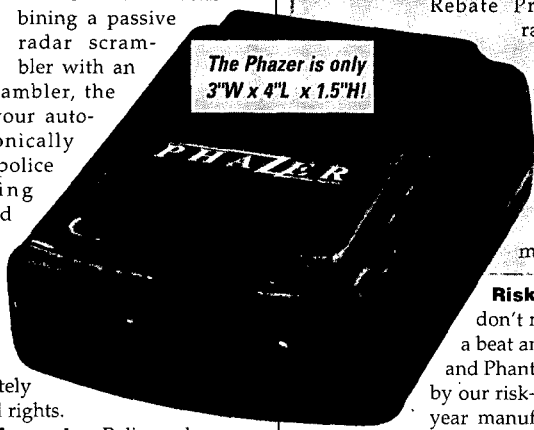
How to make your car invisible to radar and laser

Rocky Mountain Radar introduces a device guaranteed to make your car electronically "invisible" to speed traps—if you get a ticket while using the product, the manufacturer will pay your fine!

■ *The Phazer will "jam" both radar and laser guns, preventing police from measuring your speed.*

As speed-detection technology has gotten more and more advanced, speeding tickets have become virtually unavoidable. And although devices exist that enable motorists to detect these speed traps, they are outlawed in many states... including mine.

The solution. Combining a passive radar scrambler with an active laser scrambler, the Phazer makes your automobile electronically "invisible" to police speed-detecting equipment. And unless you are a resident of Minnesota, Oklahoma or Washington, D.C., using the Phazer is completely within your legal rights.



How it scrambles radar. Police radar takes five to 10 measurements of a vehicle's speed in about one second. The Phazer sends one signal that tells the radar the car is going 15 m.p.h. and another signal that the car is going 312 m.p.h. Because police radar can't verify the speed, it displays no speed at all.

Works with laser, too! The Phazer also protects your vehicle from Lidar guns that use the change in distance over time to detect a vehicle's speed. The Phazer uses light-emitting diodes (LEDs) to fire invisible infrared pulses through the windshield. Laser guns interpret those pulses as a false indication of the car's distance, blocking measurement of your speed.

Encourage responsible driving. While the Phazer *is* designed to help you (and me) avoid speed traps, it *is not* intended to condone excessive speeding. For that reason, within the first year, the manufacturer will pay tickets where the speed limit was not exceeded by more than 30%, or 15 miles per hour, whichever is less.

Double protection from speed traps. If the Phazer sounds good, but you prefer to be *notified* when you are in range of a police radar, the Phantom is for you. The Phantom combines the Phazer (including the Ticket Rebate Program) with a radar detector. It's legal in every state except Minnesota, Oklahoma, Virginia and Washington, D.C. Ask your representative for more details!

Risk-free. Speed traps don't make my heart skip a beat anymore. The Phazer and Phantom are both backed by our risk-free trial and three-year manufacturer's warranty. Try them, and if you're not satisfied, return your purchase within 90 days for a "No Questions Asked" refund.

The Phazer:
Three credit-card payments of $66.50 $14 S&H

The Phantom:
Three credit-card payments of $116.50 $18 S&H

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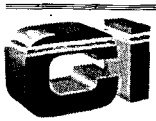

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